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CHILE'S NEW WATER CODE AND AGRARIAN REFORM: A CASE STUDY

by

Douglas B. Jensen

All views, interpretations, recommendations, and conclusions expressed in this paper are those of the author and not necessarily those of the supporting or cooperating organizations.

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I. INTRODUCTION

The 1967 Chilean Agrarian Reform Law¹ appears to have been proposed in order, among other things, to dismantle the existing agricultural power structure, which at one time had wielded a great deal of political, social, and economic power. In very general terms, the agrarian reform movement could be viewed as an oppressive burden on the latifundistas (large landholders) and the replacement of their decisions with those of technically-specialized government officials: the exchange of an oligarchy for a technocracy. The agrarian reform proponents believed that the latifundistas had failed to move from a land-based feudal system to a commercial, industrialized society. The conviction of the agrarian reform advocates seems to have been that the latifundistas had not been good managers: that they had failed to use modern techniques to make more efficient and productive use of their land and water, and that they had not been socially conscious enough to provide the campesinos (peasants) more opportunity to partake of the advantages of present-day society.²

Whatever the political, economic and social motives, and their validity, the Agrarian Reform Law does delegate much responsibility to government officials, in effect making them the new managers. In the specific case of water, the articles providing for "standards of rational and beneficial use" and "areas of rationalization of water use" concretely demonstrate the delegation of authority, the goals the new managers hope to achieve, and the means they now have to accomplish their objectives.

The present study will examine the first application of these two new concepts of government control of water rights introduced by the 1967 Agra-

rian Reform Law, which contains the most recent modifications of Chilean water law. These concepts, now incorporated into the 1969 Water Code,³ are that the central government can annul all the existing water rights in an area, known as an "area of rationalization of water use" (área de racionalización del uso de agua), and then redistribute water rights for specified monthly volumes of water per hectare (2.47 acres). These volumes are known as "standards of rational and beneficial use" (tasas de uso racional y beneficioso). These new tools have been used for the first time in conjunction with the Chilean agrarian reform program in the Choapa Valley.

Before discussing the legal concepts involved in the new and old water laws, the practical problem facing the Chilean government in the Choapa Valley should be outlined. That valley is located some 150 miles north of Santiago in Chile's Norte Chico region. Most of the regional crops, such as wheat, beans, peppers, tobacco, and walnuts, require irrigation. The water is taken almost exclusively from rivers without water storage facilities and delivered by a canal system. The Choapa, like other river basins in the region, is characterized by periods of water shortage and, therefore, by recurrent conflicts about water distribution. One such period occurred in 1968-69, one of the driest years in the recorded history of the Choapa Valley and of Chile in general. As a result, the government took emergency measures, which will be discussed later.

Also during the 1968-69 agricultural year,⁴ the agrarian reform process was reaching an advanced stage in the Choapa Valley. It was in this valley in 1964 that the agrarian reform agency, CORA (Corporación de la Reforma Agraria), acquired some of its first land.⁵ CORA had planned to assign part of that land and the pertinent water rights in late 1968 to the campesinos

and their cooperatives. CORA's problem was that it felt that the duly recorded water rights were confused and irrelevant to the irrigation needs of the various parcels to be assigned.⁶ At least on its own land, CORA had ignored those rights and had made an effort to distribute water in proportion to the surface area of irrigated land in each parcel.⁷

CCRA, owning an estimated 90% of the water rights along the Choapa River, wanted to clarify them and to adapt them to the necessities of each parcel before fragmenting water rights ownership by assignment to the campesinos. CORA therefore decided to apply the new provisions of the Agrarian Reform Law dealing with "areas of rationalization" and "standards of rational and beneficial use." These provisions would allow CORA to nullify the old water rights and calculate new ones according to the irrigation needs of each parcel.

The purpose of this study is to describe how CORA used the new provisions in attempting to solve its practical problems of redistributing land and water rights, to describe and analyze the actual implementation of the new provisions, and to suggest what legal, administrative, and technical obstacles might prevent the full use of centralized redistribution of water rights to accomplish the aims of the Agrarian Reform in the Choapa Valley. To carry out this study it is essential to describe the history of Chilean water law, the concepts of an "area of rationalization" and of a "standard of rational and beneficial use," the pertinent Agrarian Reform Law articles, and the presidential declarations applying them to the Choapa Valley. Further, it is necessary to examine the history of the valley, its agricultural and irrigation systems, and its recent experiences with administrative redistribution of water. In sum, this article will attempt to provide a case study of the making and application of the new Chilean water law.

II. A BRIEF HISTORY OF CHILEAN WATER LAW

The history of water rights in Chile begins during the Spanish colonial period, in which water and other natural resources were the property of the Spanish Crown.⁸ Water was considered a resource to be used by the public in general and to be held in common. Because of this theoretically communitarian nature of water, there was some question as to whether or not rights for private water use could be granted. But the Crown did grant concessions called mercedes to private parties for the use of land and water. Legal theorists discussed whether or not the rights granted by the mercedes were private parties for the use of land and water. Legal theorists discussed whether or not the rights granted by the mercedes were private property rights. The argument has never been settled, but the most acceptable conclusion is that the Crown's mercedes granted the rights to use the waters, but not to own them.

The same principle of public ownership of water was retained after Chile's independence from Spain in 1810. The Chilean Civil Code of 1855 affirmed that most waters flowing in natural watercourses, such as rivers and streams, were "national property for public use" (bienes nacionales de uso público).⁹ The Code honored the mercedes granted before the promulgation of the Civil Code, riparian rights for those owning land bordering a natural watercourse, and water rights thereafter granted by public authorities. Once again, the nature of those water rights was disputed. The problem, as before, was whether the State could grant or recognize a private property right over water, which was to be held in common by the citizens of the nation. In practice, however, water rights came to be regarded as private property. That is, water rights could be bought and sold, apart from land, in market transactions. But the number of such transactions is un-

known. Legal conflicts over water rights were taken to civil courts and governed by private contract law. In short, water resources, once allocated, were reallocated, if at all, through a private market process.

The 1951 Water Code collected, codified and modified Chilean water law.¹⁰ State ownership of water resources was increased by declaring ground water and water in artificial channels such as canals to be "national property for public use."¹¹ Thus there remained only a very small part of Chilean water resources that were not "national property for public use." Those private waters were springs that originated, flowed and terminated on the same property, and lakes not navigable by vessels larger than 100 tons.¹²

The Code also made changes in the form, nature, and administration of water rights in order to clarify the powers of the holders of such rights. Henceforth water rights were to be granted only by the President of the Republic and were to be held in the form of a "right of advantageous use" (derecho de aprovechamiento).¹³ The President was to grant this new water right to private parties, who would then have the powers of "use, enjoyment, and disposition" (uso, goce y disposición) over that right.¹⁴ However, if the right was granted for a particular purpose such as irrigation, it would lapse if the water were put to a different, e.g. industrial, use.¹⁵ Also, if the right, or part of it, was not exercised for five years, the part not exercised would lapse if the President of the Republic so declared.¹⁶ But no doubt was left that the holder of such a right had substantial ownership powers over it, including the power to sell it. Again, such sales did occur in which water rights were sold apart from the land, but the extent of such sales is not known. In a variant of these transactions, landowners sold part of their land, but kept part of the water rights that had pre-

viously pertained to the transferred parcel.

Although private sales of water rights could result in the concentration of such rights in the hands of a few wealthy irrigators, the government's initial granting of water rights was probably more responsible for any such concentrations. Before 1951, government entities ranging from municipalities to the national government dispensed water rights, and the grants seem to have been for the quantity of water requested by the landowners. Since there was no charge for the water rights, and since the landowners presumably wanted rights to large volumes of water to achieve security in case of drought, and also to acquire political and social power in general, the requests and the resulting grants were large. If the landowners later wanted more water rights, they could buy or rent them. Thus, many observers believe that the volume of water for which rights were granted had little relation to the area of land being irrigated, and that sales of water rights led to further disparity between water rights ownership and actual irrigation needs.

Article 43 of the 1951 Water Code attempted to restrict new irrigation water rights by allowing grants only to landholders who could justify their needs for such water rights, and then only in the amount that "corresponds to the lands they are going to irrigate, according to their size and nature, and to the available river flow from which they are going to divert water." In response to this article, the Irrigation Administration (Dirección de Riego) did begin to restrict new grants to water rights by using a general standard of one liter per second per hectare.¹⁷ But by that time, water rights previously granted evidently included most of the water in rivers used by irrigators.

Correcting this alleged concentration of rights to water, as well as to land, was one of the aims of the proponents of the 1967 Agrarian Reform Law. According to President Eduardo Frei in his message presenting the proposed legislation to the Chilean Congress, large-scale expropriation and re-allocation of land and water rights would increase agricultural production, redistribute wealth, and integrate the campesinos, or peasants, into the national consumer society.¹⁸ The Agrarian Reform Law was passed, and went into effect in July 1967.

III. A SUMMARY OF WATER RIGHTS LEGISLATION IN THE 1967 AGRARIAN REFORM LAW

A. Water Law Reformers

To determine whether or not the declarations of an "area of rationalization of water use" and "standards of rational and beneficial use" in the Choapa Valley will help accomplish the goals of the Chilean Agrarian Reform Law, we must first examine the legislative history of the pertinent articles to learn what goals the drafters sought to achieve by giving the State the power to make such declarations.

For many years the Christian Democratic Party had discussed agrarian reform. Its candidate, Eduardo Frei Montalva, won the Presidential election of 1965 and named a committee of agronomists, engineers, lawyers, and legislators to draft an Agrarian Reform Law.¹⁹ Party discussions were thus amplified and directed toward the drafting of specific legislation. When a complete agrarian reform project with new water law provisions was planned, there was general agreement among the committee members that they should modify both the 1951 Water Code and the actual pattern of water use.

Elements of politics, technology, and economics are evident in the objectives of the drafters of the water law articles. These objectives appear to have been to increase government control of water rights administration, to reduce the concentration of water rights ownership among the latifundistas, to impose centrally planned technical standards of water use, and to pay as little compensation as possible for expropriating water rights.²⁰ The drafters had to choose between three basic systems of water allocation: (1) a free market, (2) a government controlled pricing system, and (3) a centralized scheme of allocation without regard to prices.²¹ The drafters

agreed that they wanted to destroy whatever free market had existed in water rights. They believed that such a market was contrary to the original status of water as public property and that it had helped cause the very concentration of water rights holdings that they were trying to dissolve. The drafters concluded that private water users should no longer have power to make decentralized, private decisions regarding water rights ownership and water use. The result was that the Agrarian Reform Law rejects the free market theories contained in the 1951 Water Code.

The second choice, that of controlling the volume of water use by charging a price based on the amount of water used, would have left some decision-making power to the individual water user. He would not have been able to bargain over the sale or rental price of a given water right, but he could decide how much water he would purchase by equalizing the marginal value of the water and its cost. The drafters rejected public pricing of water since they thought that the costs of constantly measuring water deliveries and of collecting the charges would be excessive in relation to the benefit obtained.

Instead, the drafters chose the third alternative, a technocratic, centrally planned system of allocating water resources according to calculated need.

In order to achieve this centralized system and make the necessary changes in the legal nature of Chilean water rights, Article 10, Number 10 of the Chilean Constitution was amended in January, 1967.²² This amendment summarizes the water law drafters' concepts that were later put into statutory form. It reads, in part:

The law may reserve for the national domain for public use all the existing waters in the national territory and expropriate, in order to incorporate them into said domain, the waters that are

now private property. In this case, the owners of the expropriated waters will continue using them as cessionaires of a right of advantageous use and will have a right to compensation only when, because of total or partial extinction of that right, they are effectively deprived of sufficient water to satisfy, by a rational and beneficial use, the same necessities that they satisfied prior to the extinction.
(Emphasis added)

As proposed and promulgated, Title V of the 1967 Agrarian Reform deals specifically with water rights and codifies the significant legal changes, previewed in the constitutional amendment, that demonstrate the drafters' desire to accelerate the trend toward greater central control over water use.²³ First, all waters were declared to be "national property for public use."²⁴ Consistent with this declaration, control of all water use was placed in administrative hands, leaving the water rights holders clearly in the position of concessionaires. To make manifest this position, the legal nature of a "right of advantageous use" was changed from a private property right in rem (derecho real) to an administratively-controlled property right (derecho real administrativo).²⁵ Though the full meaning of this change is not yet clear, the new nature of water rights signifies that legal issues or conflicts concerning those rights will be decided according to the provisions of administrative law in administrative tribunals, rather than according to private property law concepts in traditional civil courts. The general object of the change is to make clear that the "right of advantageous use" represents a concession by the central government, and that the exercise of that concession will be much more closely controlled than in the past.

Title V specifically limits the powers of a holder of a "right of advantageous use"; it derogates his prior power to alienate the right apart from

land and restricts his range of "use and enjoyment" of that right. The holder of the right cannot sell it to any other person.²⁶ Even when the holder sells land for whose irrigation the water right was originally granted, he must present a proposed water division plan to the central government for approval.²⁷ If he does not do so, the government is obliged to declare the right forfeited without compensation (caducado).²⁸ The government must also declare forfeited a water right if its holder does not exercise it for two consecutive years or suspends the activity for which the right was granted.²⁹ The government may, but is not required to, declare a water right forfeited without compensation in cases where its holder (1) puts water to a different use than that for which the right was granted, (2) diverts water from a river for irrigation that is not "necessary," or (3) does not construct, modify, or maintain irrigation works according to government instructions.³⁰

B. "Standards of Rational and Beneficial Use"

Perhaps the most important restrictions on the water with which this article is primarily concerned, are those concerning the amount of water that can be used for irrigation. In general, the irrigator is legally allowed to divert from rivers "only amounts of water adequate for necessary irrigation."³¹ After setting out this general standard, the drafters went about giving the central government the highly important power to extinguish old water rights and to quantify the volume of irrigation water considered "necessary" in a specific agricultural region. The agronomists and engineers among the drafters were familiar with means of judging the amounts of water necessary for irrigation in different agricultural settings. These technicians had at their disposal such tools as the Blaney-Criddle tables, which could be used to specify the quantity of water that various

plants consume during their productive growth. By redistributing water rights in accordance with these calculated irrigation needs, the drafters hoped to achieve more complete government planning of water use.

The technical experts were eager to apply their scientific tools to water management, and the drafters concerned with politics or public administration were also pleased to have more objective standards in Chilean water law. As noted before, after passage of the 1951 Water Code, the Irrigation Administration had used a very general objective limit in conceding water rights; but that limit of one liter per second per hectare did not take into account all the variables in an exact calculus of irrigation needs. Furthermore, the Irrigation Administration granted water rights without making an adjustment for seasonal variations in river flows and irrigation requirements. The irrigator was granted a water right for a given number of liters per second as a continual flow throughout the year, even though he needed that flow for only part of the year. From the drafters' point of view, much water was being wasted because of water rights holdings that were considered to be excessive in relation to actual need. The practical result was that the constant delivery of water drastically limited the volume of water available for storage in proposed reservoirs, thereby making their construction impractical. President Frei stated in his Congressional message that attempts had been made to have the water rights holders renounce their rights, but that those attempts to "achieve voluntary renunciation of excess [waters] had failed."³²

To solve these water allocation and planning problems, the drafters decided to give the government the power to decrease and restrict water rights by declaring the "standards of rational and beneficial use" men-

tioned previously. These "standards" would basically be legal tools for enforcing the irrigation standards familiar to the engineers and agronomists. Thus, water use would be controlled according to seasonal needs by allowing an irrigator a monthly volume in cubic meters per hectare based upon different crop needs, climates, and irrigation methods.

Article 106 of the Agrarian Reform Law defines a "standard" and the criteria to be used in fixing it:

The standard of rational and beneficial use shall be understood as follows: for irrigation water, the annual volume of water, with its monthly distribution, necessary to carry out the cultivation of one hectare of land, considering the predominant or preferred crops of the regions, its ecological conditions and the use of efficient irrigation techniques. The maximum annual volume with its monthly distribution shall be determined for a farm on the basis of the standard of rational and beneficial use per hectare multiplied by the number of hectares to be irrigated.³³

Article 105 requires publication of the proposed "standards" after they have been calculated and allows thirty days for irrigator grievances before the "standards" are officially declared.³⁴

Though the term "rational and beneficial" is common in water codes and related judicial decisions,³⁵ the term is particularly instructive in this instance since it explains the drafters' view of their mission and discloses the political and fiscal advantages of their approach. "Rational" expressed the drafters' desire to change to technocratic decision-making and gave the impression of objectivity. "Beneficial" justified limited indemnity for expropriated water rights that were considered to be excessive since they were not necessary and not being put to a "beneficial use." The "standard of rational and beneficial use" controls the amount of compensation to be paid when water rights are redistributed. An irrigator left with less water than that specified in the "standard" will be compensated for the loss in value of his irrigated land due to its receiving less than

the "standard."³⁶ Thus, the law does not provide for compensation for any expropriated water in excess of the volume declared necessary by the fixed "standard." The drafters evidently reasoned that to confiscate such excess rights would not harm their holders since they would still have the water "necessary" to them. This restricted indemnity will no doubt produce considerable savings to the government in compensation payments. It might also be argued that the drafters did not want to perpetuate the existing agricultural power structure by merely replacing water rights with money.

In sum, the "standard of rational and beneficial use" is a legal tool allowing the application of technical criteria to the distribution and redistribution of water rights. Unlike many legal provisions governing the quantity of water to which rights are granted, the Chilean Agrarian Reform Law's article defining the "standard" demands the use of some scientific data in the calculation of water needs. However, the technicians are left with broad discretion in formulating and using that data. Though such delegation of authority is necessary in a centralized system of water rights administration, as the case of the Choapa Valley will show, legislators or lawyers should not be unduly optimistic about the ability of the engineers or agronomists to calculate the "standards" precisely and to apply them readily in the field.

C. "Area of Rationalization of Water Use"

Having established the concept of the "standard," the question became by what legal procedure and on what scale to reform the existing, often confused, water rights. The drafters believed that chaos would result if all water rights in the nation were cancelled while the technical

specialists computed and declared "standards." No water user would have known what water rights he had until all the necessary studies had been completed, a lapse of time that the drafters knew would be intolerably long. Therefore adopting a regional approach of reforming one river basin at a time seemed advisable.

The drafters created the "area of rationalization of water use" as the statutory means for the central government to extinguish all existing water rights, as sanctioned by the amendment of Article 10, Number 10 of the Constitution. Then new water rights could be granted according to the declared "standard," and there would be no question thereafter that the previous water rights had been nullified and replaced. Also, planners could project and specify water use in an entire river basin. The "area of rationalization" tool would allow the planners to accomplish river-basin planning and to apply calculated "standards" with a swift administrative procedure that would leave the new water rights in undisputed control.

As the committee had decided that water law reform should proceed on a limited geographical scale in order to avoid disrupting the nation's water rights, the drafters also decided to avoid similar disorder within each "area of rationalization." Though existing water rights were to be annulled water use was to continue as though they were still in effect. Presumably the drafters sought to decrease opposition to the proposed law and to avoid any political instability that might result from abrupt changes in the water rights structure.

Article 117 provides for declarations of an "area of rationalization" and explains the exact effect of such a declaration:

The President of the Republic may establish by supreme decree areas of rationalization of water use.

Once a decree establishing an area of rationalization of water use has been published in the Diario Oficial, all the existing rights of advantageous use in the area shall be null and void, but until the General Water Administration grants new rights of advantageous use, the water users may continue to use water as they had done before...³⁷

The combination of an "area of rationalization" and a "standard" gives the technical specialists the opportunity to control water use according to the methods in which they were trained. These declarations also allow the administrators swift and potent means of reallocating water rights. Water users have a chance to voice grievances about the "standard," but once an "area of rationalization" is declared and a "standard" fixed, the newly granted water rights are to be unquestionably clear and binding.

D. Other Government Powers to Reallocate Water

While the "area of rationalization" involves reallocation of water among users, the Agrarian Reform Law also provides for reallocation between different uses. Article 107 deals with instances in which the central government elects to put water to an industrial or domestic use, rather than to its present agricultural use.³⁸ That article empowers the government to expropriate water rights, paying compensation, when water is needed for "drinking or other domestic uses," or for "the economic development of a zone."

Title V also provides for complete, but temporary, control of water distribution during droughts. According to Article 101, the President can declare "drought zones" (zonas de escasez) within which the government may without paying compensation, suspend the effect of existing water rights and "redistribute the available water to reduce to a minimum the general damage caused by the drought."³⁹

E. Water Rights Administration and Water Delivery

At this point, the difference between water rights administration and physical water delivery should be clarified. Water rights administration deals with the initial granting or distribution of water rights, as well as with their nullification and redistribution. The application of "standards of rational and beneficial use" is an example of such redistribution of water rights. Actual water delivery involves the building, maintenance, and day-to-day manipulation of water conveyance systems such as rivers and canals.

Water rights administration before the 1951 Chilean Water Code was conducted by many types of government units ranging from municipalities to the national government. But since 1951, administration has been centralized. Though the 1951 Code provided for the establishment of a General Water Administration (Dirección General de Aguas), it was never formed, and its functions were delegated to the Irrigation Administration in the Ministry of Public Works.⁴⁰

Actual delivery of irrigation water in Chile has been accomplished through private organizations. Canal Associations (Asociaciones de Canalistas) were legally recognized as early as 1908.⁴¹ The 1951 Code later provided for three types of water users' organizations. The three are Canal Associations, Water Communities (Comunidades de Aguas) and Supervisory Councils (Juntas de Vigilancia).⁴² Both the Canal Associations and Water Communities are made up of persons who use water from the same canal. Supervisory Councils, on the other hand, are composed of persons or organizations, such as the Canal Associations or Water Communities, that divert water from the same river.

When the drafters of the 1967 Agrarian Reform Law began their water law reform, they considered placing both water rights administration and water delivery responsibilities in the hands of one large government agency. But when the drafters made an inventory of government personnel actually qualified to staff such an agency, they found very few persons with the necessary experience.⁴³ An enormous expenditure would have been necessary to create and maintain the agency.

Various proposals were suggested and rejected. These included irrigation districts, a new department in the Ministry of Agriculture, and a Ministry of Water Resources combining the functions of several government agencies dealing with water use.

In the end, the drafters concluded that the division of authority established in the 1951 Water Code should be maintained. The private irrigators' organizations would continue to deliver water, and water rights administration would remain under government control. Like the 1951 Code, the 1967 Law as proposed and passed provides for a General Water Administration that is to apply the Chilean water law, to grant water rights, to carry out technical studies, to develop water resources, and to supervise the private water delivery organizations.⁴⁴ The Administration has recently been established, using personnel of the Irrigation Administration.⁴⁵

From this brief summary of the water law changes made by the Agrarian Reform Law, it should be evident that the Chilean government now has extensive powers to redistribute water rights and control water use in the manner it deems convenient. The two tools that most vividly exemplify the increased government power are the "standard of rational and beneficial use" and the "area of rationalization." Now let us examine the first valley in which "standards" and an "area" have been declared, and in which the government is exercising its new managerial control.

IV. THE CHOAPA VALLEY: IRRIGATION AND AGRARIAN REFORM

A. General Description

The Choapa Valley is, as are most valleys in Chile, a transverse valley cut by a river flowing almost directly to the Pacific Ocean from headwaters high in the Andes. The Valley is located some 150 miles north of Santiago, Chile's political capital and economic hub. It is in the southern part of the zone known as the Norte Chico, which is a transition zone between the super-arid Norte Grande zone to the north which contains the Atacama Desert, and the mediterranean zone of Central Chile to the south which contains large population centers and rich agricultural areas.

The valley's climate is hot, dry, and sunny. The rainy months are June, July, and August (winter in Chile), but the rainfall is often scarce. The average annual precipitation varies from 8.4 inches on the coast to 13 inches at Cuncumén at the head of the main valley.⁴⁶

The watershed contains approximately 3000 square miles, drained by the Choapa River and its main tributary, the Illapel.⁴⁷ The Choapa's average annual flow as it emerges from the Andes is approximately 350 cubic feet per second. The lowest flow of approximately 150 cfs. occurs in April, while the highest flow of roughly 780 cfs. is reached in November.⁴⁸

The river basin contains two main population centers: Illapel, with approximately 11,000 inhabitants; and Salamanca, with a population of around 4,000. The valley's total population in 1969 was some 60,000.⁴⁹

The main economic activity in the valley has long centered around mining and agriculture. At the time of the Spanish Conquest, the Indians were mining gold along the Choapa River. The King of Spain or his representatives rewarded the conquistadores for their exploits by giving them mercedes, grants of land and water, and encomiendas, rights to use the Indians

as laborers.⁵⁰ These rights carried with them the obligation to Christianize the Indians; regardless of whether or not the soldiers fulfilled this obligation, they were left with huge expanses of land. Eventually gold mining was replaced by livestock raising. The large livestock ranches were known as estancias or haciendas and were usually kept within family ownership through the Chilean War of Independence in 1810 and on into the twentieth century.

B. A Summary of Land Tenure in the Choapa Valley

Since the "area of rationalization" with which we are concerned excludes the tributary valleys and includes the main part of the Choapa Valley, we shall briefly trace the history of landholding there. In the sixteenth century, Juan de Ahumada received a merced and encomienda comprising the entire upper valley. That landholding was kept within the Ahumada family until the nineteenth century. Doña Matilde de Salamanca, the wife of a fifth generation Ahumada, Don Gaspar de Ahumada, renewed the royal grant in 1776⁵¹ and died in 1820 without having had children.⁵² The Hacienda Choapa, as it was known by then, passed by her will. An examination of her will and the subsequent transfers of the Hacienda Choapa provides a vignette of Chilean history.

Doña Matilde stated in her will that since she had neither living ancestors nor legitimate descendants, she wished to name her soul as the sole heir to the residue of her estate.⁵³ That residue included the Hacienda Choapa. Since she specified that her residuary assets be invested by her executor for the spiritual benefit of her soul, the Hacienda Choapa was placed under the administration of the Bishop of Santiago, José Santos Rodríguez Zorrilla.⁵⁴ Unfortunately for the Bishop, he supported the losing royalist forces in the Chilean War of Independence. When the new nation-

alist leaders came to power, they asked the Bishop, who evidently had considerable political influence, to leave Chile. He complied. However, in 1821 he was allowed to return to Chile on the condition that he live in Melipilla, some 35 miles from his sphere of influence. Later that year, he succeeded in convincing the national leaders that he was interested only in the "strict care of the souls for whose welfare he was responsible as a prelate," and requested that he be allowed to return to Santiago, the seat of the diocese, to better exercise his spiritual duties.⁵⁵ General Bernardo O'Higgins accepted the Bishop's request, on the condition that the Bishop contribute to the government the assets of Doña Matilde that he administered. The contribution was to help finance the construction of an orphan's home, said to be one of General O'Higgins' favorite projects. The Bishop accepted the condition; and in Melipilla on August 17, 1821, he signed the contract transferring Doña Matilde's assets to the Council that General O'Higgins was to name and charge with the responsibility of establishing an orphan's home. The Bishop stated that he made the transfer under the powers conferred upon him by the Council of Trent, "which allows the delegates of the Holy See to alter last wills and testaments and to substitute one pious work for another when necessity and public utility intervene."⁵⁶

General O'Higgins, by a decree dated September 1, 1821, named the members of the Santiago Beneficence and Social Assistance Council (hereafter referred to as the Beneficence Council) to construct and administer the orphan's home and to take charge of the Hacienda Choapa.⁵⁷ The Beneficence Council later rented out part of the Hacienda to private parties.

In the 1930's, several ownership changes occurred in the Choapa Valley. General financial setbacks caused some families holding private land in

parts of the main valley downstream from the Hacienda Choapa and in tributary valleys to sell portions of their land. Some land was sold to private buyers and other portions were sold to the government Office of Agricultural Colonization (Caja de Colonización Agrícola), which was carrying out an early agrarian reform program by forming colonies of small farmers.⁵⁸

The Hacienda Choapa also changed hands, but still remained under government ownership. In 1933 the National Health Service (Servicio Nacional de Salud, SNS) became the owner of the Hacienda.⁵⁹ The SNS appointed various administrators to handle each farm into which the Hacienda had been divided. Some observers believe that these administrators lacked technical and managerial expertise and were chosen on the basis of their political connections.⁶⁰ Whatever the explanation, it is generally acknowledged that the farms were not efficiently and productively controlled by the SNS.

In 1964 the Hacienda Choapa was transferred to CORA, which was established by the earlier 1962 Chilean Agrarian Reform Law.⁶¹ Now CORA has owned, owns, or is in the process of expropriating the vast majority of land in the Choapa Valley, as well as in the tributary valleys. While CORA is increasing its landholdings, it is also decreasing them by transferring many of the farms in the Hacienda Choapa to the campesinos, and more such transfers are planned for the very near future. As noted before, these transfers prompted CORA to examine and to decide to redistribute water rights in the main Choapa Valley by having President Frei declare an "area of rationalization" and "standards of rational and beneficial use."

But before examining the CORA program that led to the title transfers and the declarations, the Choapa Valley's agriculture and the irrigation system should be described.

C. Crops and Irrigation

Throughout the past agricultural history of the valley, land was not used intensively. Land was held in such large parcels that owners received sufficient total income without high per-hectare profits. Further, the social system provided much unskilled labor and the property tax system did not demand high per-hectare efficiency. As a result, the traditional agricultural pursuit was raising livestock in such a way that land was extensively, but not intensively, used. Though the number of livestock has been decreasing, livestock will probably always provide a significant part of the area's agricultural income, since livestock can take advantage of the vegetation that manages to grow on the rocky, thin soil of the foothills and mountains bordering the river.

As livestock raising has decreased in importance, and as landholdings have been fragmented, land use has become more intensive. Originally, wheat and other low-intensity crops that required little, if any, irrigation and a small number of man-hours to produce were predominant. Now there is greater crop diversity and intensity and greater needs for irrigation water. The main crops are wheat, beans, peppers, tobacco, corn and walnuts, with new and increasing plantings of apricots, peaches and grapes.

Unfortunately, there is only a small percentage of land that is suitable for irrigated farming. Because the valley is steep and narrow, the rich alluvial soil that can be reached by irrigation canals occupies only a very small area, namely the river flood plain and low foothills. For this reason, only 4% of the Choapa River basin area is irrigated.⁶²

Increasing the productivity of irrigated crops in the Choapa Valley will be difficult not only because of soil conditions and geography, but also because of the limited amount of river water available for irrigation.

Because there are no reservoirs on the stream and almost no use of ground water, the supply of irrigation water depends on the annual cycle of the river. As noted before, the magnitude of the yearly variation is quite large. The spring thaws recede quickly before the summer months, when the valley's irrigation needs are greatest.⁶³

Although there are no water storage facilities, natural conditions in the river valley do delay and lengthen the river's annual extremes. There are three types of natural retention and recuperation in the valley's hydrologic cycle. A natural dam on the Choapa's headwaters collects and slowly releases the spring run-off, thereby helping to moderate and delay the river flow peaks. Downstream, some of the water that is extracted from the river filters back to it for re-use. Finally, a number of impervious vertical rock dikes intersecting the river force its underground flow to well up into the surface flow in a type of spring (afloramiento).⁶⁴

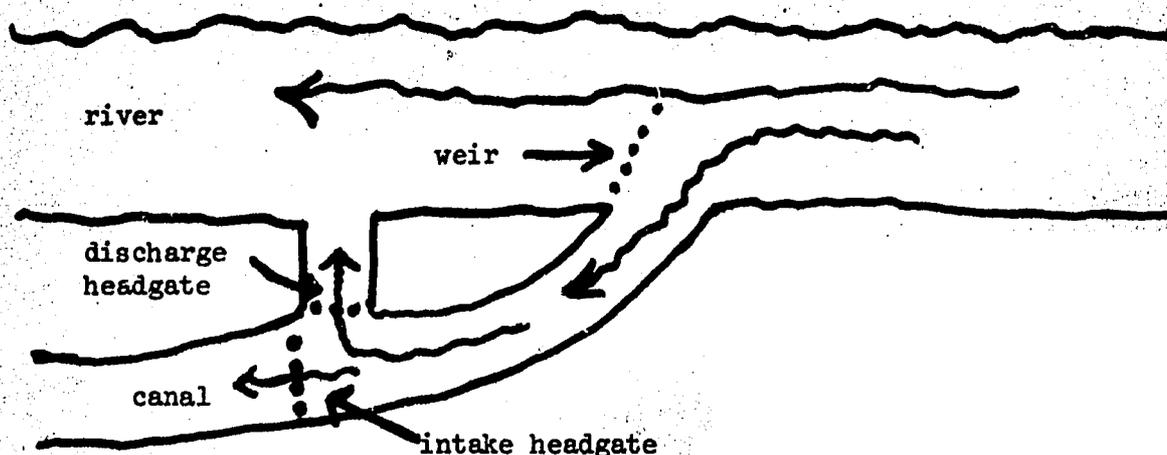
The recovery of water by return-flow, percolation and the rise of the river's underground flow to the surface not only regulate the river's flow, but also, in effect, increase its original flow by recuperating water that would otherwise be lost. Engineers have calculated that due to these recuperations and water contributed by small affluents, the irrigators in the upper third of the valley have available for use 145% of the river's volume as measured at the head of the valley proper.⁶⁵

Though the irrigators have pleaded with the national government for many years to build large dams along the river, there seems little hope that the studies completed for such a reclamation project will be implemented.⁶⁶ However, CORA is now constructing small reservoirs on each of the Hacienda Choapa farms it acquired and is transferring to the campesinos.⁶⁷ These

reservoirs, known as "night reservoirs" (tranques de noche), are to store for daytime irrigation the water that would otherwise pass by the farm at night. Although it would seem that this water would be used in the morning further down the canal or river, CORA and local irrigators insist that the reservoirs lead to more efficient water use. They maintain that if an irrigator has his total quota of water collected for use within a few hours, instead of having the same amount of water delivered at a slower rate over a 24-hour period, he can irrigate more of his land because the aggregated volume of water will spread more completely over his land. The irrigators also say that daytime irrigation allows better control of the water and reduces labor costs. In any even, the reservoirs will help measure the volume of water used on each farm.

The existing net of some 34 canals taking water from the upper half of the river remains the principal irrigation works on the Choapa River. Many of the canals were constructed in the last century and are primitive.⁶⁸ River water is diverted into the canals by a bocatoma, a diversionary weir, constructed by placing boulders and debris in the river bed. Since these headworks cannot regulate the amount of water diverted into the canal, an intake and discharge works performs that function. This works is composed of two headgates, each of which consists of a wooden frame along the bottom and sides of the canal, and a plank that slides up and down in the frame slots. The plank is lowered and raised to regulate the flow past the headgate. Two headgates are necessary for the works to function. The intake headgate stands astride the canal, and when the plank is lowered partially, the water that backs up flows back to the river through the discharge gate, which forms an opening in the downhill side of the canal. Ma-

nipulating the two headgates regulates the volume of water allowed to pass into the canal.



The problem is that these works cannot accurately measure and deliver a given quantity of water to the canal. The headworks cannot regulate the river flow, and when the water reaches the intake and discharge headgates, their crude construction prevents accurate measurement and control. The velocity and direction of the water flow are variable since the earthen canal sides erode and become uneven. The headgate frame becomes misshapen and leaks thereby precluding a permanent, well-defined cross-section through which the water can pass.⁶⁹ Further, the vertical movement of the plank cannot be closely controlled; there are no calibrations to regulate its position. The headgates are clearly useful, but they lack precision.

Once the water passes the headgates, in whatever quantity, further difficulties occur. As mentioned above, the canals are earthen and unlined, so considerable amounts of water percolate out of them. The amount of these percolating losses varies widely along each canal and between canals. Though some studies of such losses have been made,⁷⁰ it would be necessary to study each canal while it was carrying different volumes of water in

order to predict how much of the water put into the canal would eventually reach the irrigators. Thus, water delivery is made unpredictable by seepage losses.

Evapotranspiration losses also occur along the canals. Many of the trees and bushes along them are phreatophytes, water-loving plants which use large quantities of water and transpire it into the atmosphere without producing any economic benefit. Water also simply evaporates from the open canals. These evapotranspiration losses make precise water delivery still more difficult.

A socio-legal situation adds further complications. Traditionally, each family has had the right to take water from the canal passing by its home or plot for domestic use or for watering animals.⁷¹ Naturally, each family insists upon receiving its right. This fact combined with the campesinos' custom of spacing out their houses and garden plots along a canal means that the canal banks are perforated by a large number of takeouts. The large number of such takeouts, as well as their primitive, leaky construction still further impedes enforcement of a closely calculated water allocation plan. CORA is now changing this housing pattern in order, among other things, to lessen the water distribution problem. But even if the number of takeouts is reduced, they will have to be more tightly constructed.

In short, the combination of inaccurate canal headgates, seepage and evapotranspiration losses from the canals, and the numerous leaky takeouts make field-side delivery of a given quantity of water, such as that specified in "standards of rational and beneficial use," a most difficult task. But because in years of normal precipitation and river flow, most irrigators

have sufficient water to satisfy at least their minimum needs, there is usually little reason to be concerned about water delivery and measurement problems. Only when the water supply is restricted, or crops needing more irrigation are planted, do water allocation problems arise.

D. Water Rights and Conflicts

Though drought is familiar to the Choapa Valley, the past history of low-intensity farming seems to have lessened the number of water rights conflicts. Also, since the ownership of water rights roughly paralleled land ownership, the near monopolies of both held by the latifundistas and the government may have further controlled the frequency of disputes. But as we shall see, disputes have occurred. An examination of water rights history in the Choapa Valley and of the institutions that solved water conflicts will reveal some of the circumstances that motivated CORA to have requested declarations of an "area of rationalization" and "standards of rational and beneficial use."

The water rights pertaining to the Hacienda Choapa were inscribed in the Irrigation Department in 1930 and in the Illapel Court in 1957,⁷² but local residents say that these rights have been in effect from at least the beginning of this century. These recorded rights were transferred from the Beneficence Council to the National Health Service (SNS) and then to CORA. They were divided by farm and specified how many liters per second were to be extracted from the river for the irrigation of a specified number of hectares. In some cases, the rights were generous in comparison with the one-liter-per-second-per-hectare standard we noted earlier in discussing water rights grants by the government. One farm was to receive six liters per

second per hectare, another four, and several others three. This disparity was the cause of several conflicts among the farms.

But the fact that there were some recorded rights does not signify that the water rights regime in the valley was orderly. In 1963 a study of the valley's water resources briefly portrayed the "imperfections and defects" of the recorded water rights:

- a. The recording has been done by grantee and not by canal, although the names of both are mentioned.
- b. There are recordings in both liters per second (the majority) and in regadores, a unit without definition.
- c. The recorded rights add up to much more than the river's flow during its lowest stage.
- d. There are canals and irrigators who have no recorded rights.
- e. It is not known if those rights were being exercised at the date of the promulgation of the 1951 Water Code; nor is it known which rights lapsed--for non-use--afterwards.⁷³

Conflicts were certain to arise in this state of affairs when water shortages occurred.

In spite of the conflicts, there have been few permanent formal institutions to resolve them. Instead, from time to time ad hoc judicial or administrative interventions served to organize local irrigators and arbitrate water conflicts. Local irrigators recall that when water disputes occurred in the early part of this century, the departmental (county) judge in Illapel named prominent irrigators to arbitration boards.⁷⁴ These boards would then appoint a juez del río, literally a "river judge," but probably more accurately a water master. One such board was evidently formed, for example during the drought of 1924. The water master was shot and killed that year, and another man accepted the intermittent appointments to that post until the early 1940's.

In more recent years government intervention has proceeded in much the same manner, but with the national government playing a larger role. Article 306 of the 1951 Water Code gives the General Water Administration power to intervene in the distribution of water on a river where no Supervisory Council has been formed. The Irrigation Administration, acting as the General Water Administration, intervened several times on the Choapa River at the request of various aggrieved irrigators.⁷⁵ On each such occasion, the Irrigation Administration appointed one of its engineers as Referee. He would call a meeting of the interested irrigators and choose a Distribution Commission, and it would select a water master to execute its decisions.

The basis on which those decisions were made is not clear. There is some disagreement among participants as to whether the Commission honored the recorded water rights, or whether it followed a rule-of-thumb standard and allocated water in proportion to irrigated acreage. Since in nearby valleys the proportional rule has been followed,⁷⁶ it would not be surprising to find that in practice the proportional standard superceded the rights, which granted strict volumes to the irrigators.

On different occasions, observers and government agencies, including CORA, have recommended that a permanent Supervisory Council be established to control water delivery along the Choapa River.⁷⁷ To this writing, the Council has not been formed.

However, because of the continuing drought, the river is under the temporary, but complete, control of a special Water Distribution Commission. 1967 was a dry year, and in 1968 the Choapa Valley received almost no rain. The drought was widespread and probably the worst in Chile's history. Under the emergency powers given the President by the Agrarian Reform Law, he de-

clared the upper half of the country to be a "drought zone."⁷⁸ As was done in other river basins, a Water Distribution Commission was named in September 1968 to control the rivers and streams in the Choapa Basin.⁷⁹ Because the drought has continued in the Norte Chico, the Commission's powers were extended to May 31, 1970.⁸⁰

Those powers were virtually absolute. All the water rights in the basin were suspended without compensation, and the Commission distributed water according to the area of irrigated land, and according to a system of priorities protecting fruit trees, permanent pasture and regional speciality crops. Rotations (turnos) were established and strictly enforced, in some cases by military patrols.⁸¹

E. CORA and the Redistribution of Water Rights

After becoming the owner of an estimated 90% of the water rights on the Choapa River, CORA, like the Distribution Commission after it, ignored the recorded rights and distributed water among its farms on the basis of irrigated hectares. In 1965 a CORA engineer, Sr. Wilfred Bennison, calculated the percentage of irrigated land in the upper Choapa Valley served by each canal.⁸² The resulting percentages of the river's flow were to be diverted into the appropriate canals.⁸³ However, the figures were so exact, e. g. .12% and .36%, that the imperfections of the canal system prevented accurate delivery of the indicated quotas; but the figures did serve as a general guide.

But CORA could only temporarily control water delivery, not permanently redistribute water rights. Those rights were attached to the farms CORA was to transfer to the campesinos under the Agrarian Reform Law. The ur-

gency to assign the farms was especially acute in the Choapa Valley because one of CORA's pilot programs was being carried out there: the establishment of "settlements" (asentamientos). CORA formed a "settlement" out of each of its farms, using as settlers the campesinos who had worked there. These "settlements" were to serve as a transition between the previous farm owners and the new cooperatives that would be owned and managed by the campesinos.⁸⁴ The "settlement" was to be an institution where they could learn management and technical skills, the values of cooperative effort in production and marketing, and the advantages of living together in villages for better educational, medical, utility and consumer services.

By the agricultural year 1968-69, the allotted "settlement" period was ending, and CORA was to transfer land titles and water rights to the cooperatives.⁸⁵ But as we have seen, the inscribed water rights CORA had acquired were confused, incomplete, and so irrelevant to actual and prospective irrigation needs that CORA had basically ignored them. Further, by this time CORA had formulated new crop plans for the valley and did not want the new cooperatives to get water rights that were ill-defined and patently inconsistent with the development plans.

Now we shall examine those plans and the manner in which CORA extricated itself from the predicament by using the "area of rationalization" and "standard of rational and beneficial use" tools.

V. CORA'S CALCULATION OF CHOAPA VALLEY IRRIGATION NEEDS

A. Consumptive Water Use and Irrigation Needs

By the time CORA took action to annu the Choapa Valley, it had studied irrigation problems, calculated the water needs of various crops, and formulated future crop plans. CORA engineers studied several reports on the valley's hydrology and irrigation system completed before CORA acquired the Hacienda Choapa.⁸⁶ Afterwards, in 1965, Sr. Wilfred Bennison, the CORA engineer mentioned previously, presented a preliminary irrigation report. This report is a key document for the purposes of the present study, since it contains the first calculations that eventually served to fix the "standards of rational and beneficial use" later declared in the Choapa Valley. Bennison calculated the consumptive use of water by various crops in the valley by using the Blaney-Criddle formula.⁸⁷

In general terms, this formula quantifies the amount of evapotranspiration experienced by a particular crop in a given area during a specific month or an entire growing season. The formula is widely used in arid regions.⁸⁸ To estimate consumptive water use, the Blaney-Criddle equation incorporates several local climatic variables: mean monthly temperatures, the percentages of annual daytime hours occurring during the various months, and the annual growing or irrigation season. This last factor is expressed as an empirical coefficient that depends upon the stage of growth at which the crop is harvested.⁸⁹ Blaney and Criddle established seasonal coefficients, known as "K" values, or rates of consumptive use, for several crops; and the values appear to be valid in many parts of the world. The "K" can be combined with local temperature and daylight hour figures to calculate

annual consumptive water use.⁹⁰ The temperatures must be measured in the locale in question, but the percentage of yearly daylight hours occurring in a given month at a specific degree of latitude can be obtained from standardized tables.

Though the total consumptive use figures for the entire growing season are useful for planning large irrigation works, most water requirements, like the "standards of rational and beneficial use," are to be calculated on a monthly basis. For monthly calculations, Blaney and Criddle use a monthly consumptive use coefficient, "k," since plant growth and water use varies monthly as it increases, reaches a peak, and declines.⁹¹ Of course, the monthly temperature and daylight hour figures are used.

After calculating seasonal or monthly consumptive use by a given plant, Blaney and Criddle calculated how much water must be supplied by rainfall or irrigation. Irrigation needs are the plant water needs that are not provided by rainfall.⁹² Those irrigation needs are affected by application losses, such as evaporation, deep percolation and surface run-off, which prevent all of the irrigation water applied from being available for use by the plants. Therefore Blaney and Criddle make an adjustment for irrigation efficiency, i.e. "the percentage of irrigation water that is made available for consumptive use."⁹³ Irrigation efficiency depends on soil porosity, plant spacing, and irrigation methods.⁹⁴ For example, sprinkler irrigation results in high efficiency, while flooding produces the lowest.⁹⁵

Returning to Bennison's calculations for the Choapa Valley, one observes how he applied the Blaney-Criddle formula. He assigned rainfall and temperature figure that compare well with others published in Chile,⁹⁶ but his daylight hour figures are slightly different from those published in conjunction with the Blaney-Criddle formula.⁹⁷

The major problems seem to be that Sr. Bennison used a seasonal "K" value instead of a monthly "k" in calculating monthly irrigation needs; and he postulated very high irrigation efficiencies. Since Bennison used seasonal rather than monthly coefficients, his seasonal consumptive use figures may be valid, but his monthly figures will be inaccurate. The reason for such inaccuracy is that "k," like the rate of plant growth, varies every month. These variations are important: for example, in the case of alfalfa, "K" values range between .80 and .90, while the "k" values vary from .35 to 1.15 during the growing season.⁹⁸ Though it may be difficult for Bennison, or any water expert, to assign monthly "k's," it should be noted that using a seasonal "K" of .80, as Bennison did, will result in errors every month in which the monthly "k" is not .80. This calculation difficulty demonstrates one of the technical problems of accurately fixing "standards of rational and beneficial use," that is, "maximum monthly volumes of water" (emphasis added).

The "standard" is meant to limit water use not only by granting volumes that differ from month to month, but also by encouraging "efficient irrigation methods." The irrigation requirements calculated by Bennison assume that the irrigators will be very efficient. Bennison used farm efficiency figures of 65% and 70%, while Blaney and Criddle found that in the Western United States efficiencies varied between 45% on porous soil to 65% on medium loam soils.⁹⁹ Unfortunately, in Chile irrigation methods are less efficient.¹⁰⁰ Thus, another dilemma appears in calculating "standards": should the highest efficiencies be used in fixing a "standard" in order to encourage achievement of those efficiencies, or should more realistic goals be set, which might induce more willing acceptance of and more successful adherence to the "standards"? Since Article 106 simply specifies that the irrigation methods considered in the calculation be "efficient," this policy

decision is left to the discretion of the technicians computing the "standards." The entire description of the calculation of irrigation needs in the Choapa Valley demonstrates how much decision-making power was delegated to those technicians by the Agrarian Reform Law.

B. The Plan Choapa Crop Patterns

The same delegation of power is apparent when we see how CORA combined Bennison's irrigation needs figures with future crop plans to arrive at the volume of water necessary to irrigate the average hectare in the Choapa Valley. Bennison's figures simply showed the consumptive use of water by one hectare of land planted to a particular crop. To ascertain the valley's total irrigation needs, and those of an average hectare, it was necessary to know how many hectares of which crops would be planted. Since CORA had plans to change the valley's crop patterns, it fixed the irrigation needs of the average, future hectare, not one as it is presently cultivated and irrigated. Since these irrigation needs became the "standards" upon which Choapa Valley water rights are to be based, an inspection of the calculations is indicated.

The Plan Choapa is CORA's blueprint for development of the Choapa Basin and represents a major regional planning effort.¹⁰¹ Land use projections were made on the basis of "family economic units," formulated according to "economic, technical, and socio-political-economic criteria."¹⁰²

The valley was sub-divided into a number of zones and sectors on the basis of climate, soil type, steepness, and availability of irrigation water. The CORA planners formulated five "family economic units" of different sizes and crop patterns and arranged them within the appropriate zones and sectors.¹⁰³ In this fashion, the planners calculated the percentage of

land to be devoted to each crop in each subdivision of the valley. The percentage of land occupied by each given crop was multiplied by each of that crop's monthly irrigation needs figures. Then the resulting fractions of irrigation needs from each crop were added up for every month to obtain the total monthly irrigation needs for an average hectare in that section of the valley.¹⁰⁴ Thus, the average hectare's monthly irrigation needs are a weighted average reflecting the irrigation needs of the individual crops in direct proportion to the percentage of the section's area they were to occupy.

In sum, the irrigation needs were generalized; the emphasis was placed upon the average hectare's needs, not those of a particular farm. The problem is that no farm is likely to be average, that is, to have the same crop pattern as that of the entire section. Since these average hectare irrigation needs have now been declared the "standards" that will quantify the new water rights in the Choapa Valley, these average needs will govern water use on every farm there. Some inequity is bound to result, but that inequity must be balanced against administrative convenience, a highly important factor in the new centralized bureaucracy.

The CORA planners were clearly proposing remedial action; the full imposition of their calculated average irrigation needs would drastically reduce water use. The largest volume any of these "standards" would provide is approximately .73 liters per second per hectare.¹⁰⁵ But local irrigators and water managers now estimate that they use between 2 and 3 liters during peak irrigation periods. In terms of annual use in cubic meters per hectare, a 1963 study estimated that Choapa Valley irrigators used 21,400 m³/hectare.¹⁰⁶ The "standards" will grant only 13,200; 12,950; or 11,800 m³/hectare to the three sections of the valley.¹⁰⁷ Though these

restricted figures compare well with other ideal volumes suggested in other reports,¹⁰⁸ complete "rationalization" would have a major impact on water use.

VI. THE DECLARATIONS OF AN "AREA OF RATIONALIZATION" AND "STANDARDS OF RATIONAL AND BENEFICIAL USE"

A. CORA's Land Transfer Problem

While CORA was formulating the Plan Choapa, projecting land use patterns, and calculating irrigation water requirements, the time to apply the Plan was approaching. As noted before, the "settlement" period was ending, and CORA had to assign land to the new cooperatives.¹⁰⁹ The pressure on CORA to make these transfers was strong; CORA had to demonstrate to its critics, its supporters, and the campesinos that it would redistribute land as promised. All observers attached much emotional and political significance to the delivery of land title. But CORA was aware that efficient water management was essential to productive cultivation and to the long-range success of the agrarian reform program. As mentioned earlier, the inscribed water rights that CORA held and that would pass to the campesino cooperatives were not coordinated with either present or future crop plans. If those water rights were allowed to pass to the new cooperatives, the result would probably have been continued haggling and disappointing production. CORA's problem was to find a way to assign land on schedule and yet to avoid perpetuating the antiquated water rights structure.

CORA had been concerned with water rights from the beginning of its tenure in the Choapa Valley, and by 1967 CORA actively sought to solve the water rights transfer problem. In July 1968, a CORA lawyer submitted a memorandum stating that transferring the existing water rights would require an arduous definition of those confused rights and the approval of the transfer by the Irrigation Administration.¹¹⁰ Instead, the report proposed, the old rights should be nullified by declaring the Choapa Valley an "area of ration-

alization." Then new rights that were definite and equitable could be granted to the future cooperatives. The lawyer advocated declaring an "area" and reforming water rights before transferring them to the cooperatives, rather than passing on the old rights and causing conflicts by later trying to reform them.

The memorandum did point out what it considered to be a disadvantage of its proposal: restructuring the water rights would involve fixing "standards of rational and beneficial use" in order to formulate the new rights. The lawyer said that fixing the "standards" could be "troublesome," but he pointed out that the Plan Choapa calculations could be used to compute them. The proposal was accepted.

B. Declaring an "Area of Rationalization"

In August 1968, CORA and the Ministry of Agriculture proposed to the Ministry of Public Works (in which the Irrigation Administration is located) that an "area of rationalization" be declared in the Choapa Valley.¹¹¹ The arguments offered in support of the proposal were that 1) CORA held the great majority of inscribed water rights, so the Irrigation Administration would have to deal with few interested parties; 2) CORA had established an irrigation plan; 3) CORA was constructing works to carry out that plan; 4) CORA had the information necessary to fix "standards of rational and beneficial use;" 5) CORA would renounce any rights to compensation, whereas the cooperatives after receiving titles might not do so; and 6) the government should declare the first "area of rationalization" in a valley wholly owned by a public agency (CORA) that would permit the achievement of rational water use with almost no difficulty.

The requests were favorably received. On December 4, 1968 President Frei, through the Public Works Ministry, decreed an "area of rationalization in the upper Choapa Valley."¹¹² The decree ordered the nullification of all existing water rights in the "area," but allowed existing water uses to continue until new rights were granted. The decree also ordered the Irrigation Administration to complete the technical studies necessary to fix "standards of rational and beneficial use" in the "area."

As CORA foresaw and desired, the decree solved its land transfer problem without affecting actual water delivery in the valley. The obstacle to land transfer was removed, since no water rights remained to be transferred with the land. The decree raised no complaints among water users. Few, if any, irrigators, including the campesinos who were to be the final beneficiaries of the new water rights, knew of CORA's plans or had participated in making them. More importantly, the decree had no effect on water allocation in the valley: CORA had long ignored the now defunct water rights, and as the decree stated, the existing water use pattern was to continue until new water rights were granted. But the decree could not have affected water delivery anyway for the practical reason that the drought was in full force and the river was completely controlled by the special Water Distribution Commission. The Agrarian Reform Law provides for compensation when water rights are nullified in an "area of rationalization," but CORA renounced any rights to compensation, and any such compensation to private parties would depend upon the granting of new water rights for a volume of water less than that declared necessary by the "standards of rational and beneficial use." Until those "standards" were fixed and new water rights were granted, there could be no cause for complaints. There were none.

C. Declaring "Standards of Rational and Beneficial Use"

After the declaration of an "area," preparation began for the declaration of "standards" in the Choapa Valley. According to both Article 105 of the Agrarian Reform Law and the "area" decree, the technical studies prerequisite to fixing "standards" were to be made by the General Water Administration, in whose stead the Irrigation Administration was acting. But since CORA had accumulated extensive experience in the valley, had prepared the Plan Choapa, and was the valley's water manager, CORA became responsible for recommending the "standards."

CORA simply extracted the calculations of future irrigation water needs presented in the Plan Choapa and recommended them to the Irrigation Administration for declaration as the official "standards of rational and beneficial use." Because CORA's figures were roughly parallel to the Administration's studies, and because of comity between government agencies, it approved the CORA recommendations without amendment.¹¹³

The proposed "standards" were then published to allow for complaints from affected irrigators. No such complaints were received, probably because the published "standards" were very difficult to understand without a detailed explanation and mathematical calculation.¹¹⁴ In any event, local irrigators probably were not aware of what the "standards" meant. The campesinos were not consulted; indeed, CORA wanted to reform water rights before the campesinos gained control of them.

President Frei decreed the "standards of rational and beneficial use" for the Choapa Valley on April 30, 1969.¹¹⁵ But to this writing neither CORA nor the new cooperatives have petitioned the General Water Administration for the new water rights to be granted.

VII. APPLYING THE "STANDARDS OF RATIONAL AND BENEFICIAL USE"

A. Possible Obstacles

The restricted water volumes called for by the "standards" indicates that the need for improved irrigation may be great, but the difficulty of actually achieving it may be greater still. The problem of actually applying the "standards of rational and beneficial use" in the Choapa Valley is a case in point that may help future legislators who may not be aware either of the problems of calculating the "standards" or of applying them. Though CORA thought that calculating the "standards" would be troublesome, actually implementing them will be the more onerous task.

Of course, application of the "standards" will be delayed until new water rights are granted. CORA has shown no desire to have the General Water Administration grant those rights. Since the drought continues and all water rights in the valley have been superceded by the orders of the Water Distribution Commission, there is no point in granting new rights and causing discontent until those rights can have legal and practical effect. Thus, the application obstacles are appearing, but have not yet been fully confronted.

Once the new rights are granted and CORA or another entity attempts to deliver water according to the "standards," it must overcome at least three types of obstacles: physical, institutional, and socio-administrative. In the Choapa Valley, the physical problem is that the existing irrigation works cannot deliver water to the farms with the accuracy demanded by the "standards." The institutional difficulty is that water use calculations and policies must be coordinated within CORA and between CORA, the cooperatives, and the General Water Administration. The socio-administrative task is to surmount any irrigator resentment toward central administrative control of water rights and to convince the irrigators to use more efficient

irrigation methods and form the necessary irrigators' organizations.

B. Physical Realities

The unsatisfactory condition of the present irrigation works has been discussed earlier. The primitive canals and headgates, the lack of measuring flumes, the large number of crude take-outs, the various domestic rights to be satisfied, phreatophytes, and seepage losses make accurate water delivery nearly impossible under present circumstances. Further, since the "standards" state the volume of water to be received at the farm, the amount of delivery losses in the canal must be foreseen, a most difficult calculation which varies with the volume of water put into a canal. Even if such losses could be calculated, the present diversion and regulation works could not be depended upon to deliver the indicated flow into the canal. Consequently, the physical obstacles to presently implementing the "standards" are most serious.

But CORA is installing more accurate irrigation works and constructing night reservoirs. According to the Plan Choapa there are also plans to improve the canals. The night reservoirs will at least be able to measure the water that is stored and released to a particular cooperative. The new canal headgates will also help to apply the "standards." These works are permanent concrete and steel structures that insure that water flow is uniform into and through the headgates. They are calibrated to help provide accurate measurement. Nevertheless, the canal transport losses will continue to obstruct accurate water delivery until the canals are lined.

C. Institutional Coordination

The problem of institutional coordination is also serious. Within CORA itself, the fixed "standards," or Plan Choapa irrigation needs figures, have

not been strictly applied either to calculate the size of the irrigation works CORA is building or to compute the irrigation needs of the crops proposed in CORA's yearly cultivation plans in Choapa.

The "standards" had not been officially declared when the specifications of the night reservoirs and other irrigation works were being drawn up, but the consumptive use figures had been computed. Both the consumptive use figures and the specifications for the irrigation works appeared in the Plan Choapa. The authors of the irrigation study noted that none of the suggested irrigation needs would give any irrigator as much as one liter per second per hectare, but they pointed out that the capacities of the planned irrigation works had been calculated on the basis of one liter per second per hectare in order to leave a "safety margin."¹¹⁶ Whether such a margin is necessary or economical, or whether the one liter figure is simply customary and convenient in such calculations is not clear. But it does seem logical to select a maximum figure that would not have to be adjusted upward by later needs; it is most difficult and expensive to change the capacity of irrigation works after construction. The fact remains, however, that CORA did not apply the "standards" when it planned the permanent irrigation works now under construction in the Choapa Valley.

The irrigation works planners at least noted the suggested irrigation needs. The planners of the valley's annual cultivation schedules have not always done so. While there is reason for not using a potentially variable irrigation rate when planning permanent structures, no similar reason exists for not applying that rate to temporary, easily amendable cultivation plans. But the irrigation requirements calculated for CORA's 1969-1970 cultivation plans for the Choapa Valley cooperatives and "settlements" are not coordinated with the official "standards." The cultivation indicates how much

water will be needed by each farm if the proposed crops are planted. However, the CORA employee who calculated these irrigation needs stated that he made his own calculations and disclaimed any relation between his figures and the "standards." Another crop planner said that the Plan Choapa figures were "too technical" and could not be applied to the present crop plans. It appears that CORA has not made a successful effort to implement the "standards" in the Choapa Valley.

These problems of intra-agency coordination are probably easier to resolve than lack of communication between two or more agencies. Inter-agency issues have not appeared yet since CORA was given full responsibility and complete liberty in computing the "standards" in the Choapa Valley. In other cases, where CORA's interests are not as overwhelming, conflicts could result between CORA's agrarian reform policy and the water policy of another agency, such as the General Water Administration. If a "standard" were declared in conjunction with the construction of a water reclamation project, for example, differences of opinion could arise concerning the amount of the "standard" or the granting of water rights for less than its volumes. Since CORA has not yet requested that definite rights be granted in the Choapa Valley, the General Water Administration has not acted, but presumably the two agencies will agree that the rights will be for the amount of the "standards."

The variety of government agencies dealing with water has concerned observers. For that reason, the General Water Administration was provided for in the law. Other interest has been expressed in coordinating the work of the various agencies dealing with water, and in clearly delineating the responsibilities of each.¹¹⁷ Unless such interest induces effective action, classic agency rivalry and lack of communication could jeopardize full use

of the "standards of rational and beneficial use" as a water use planning tool.

D. Socio-Administrative Barriers:

The third type of possible obstacle to full implementation of the Choapa Valley "standards" is administrative and social, that is, how to fit the administrative rules to the particular farmer. Regardless of the form in which the water rights are granted, and assuming that water could actually be delivered in the amounts specified, the problem of satisfying the irrigators will still remain. Several possible complaints about the "standards" could come from the irrigators after they finally receive water rights. It should be noted, though, that individual irrigators in the Choapa Valley will not receive the rights; they will be granted to each cooperative, where an irrigation committee will then distribute water among the members of the cooperative. Though the cooperative cannot reject the water rights granted to it, the irrigators might make two plausible complaints: first, that the quantity of water granted to them is inequitable or does not fit their needs; and second, that the system is controlled by the central government.

The first complaint, about water quantity, will no doubt be raised quickly. The difference between present volumes of water use and the volumes contemplated by the "standards" is striking. The government has already decided on them, so pleas of too little water will likely be ignored. But the irrigators might also complain that the "standard" is unjust as applied to them since it was designed to irrigate a future, average hectare planted according to prospective crop patterns and irrigated with the most efficient techniques rather than to irrigate their present hectares. They may well argue that their present situation is neither average nor developed.

Some drafters seemed to believe that the "standard" would be individualized on the basis of a farm's crops, but Article 106 provides that regional crops, ecology, and climate are to be considered in calculating the "standards," and thus implies a general or average "standard" to be applied to all irrigators, regardless of their individual crops. Furthermore, as mentioned earlier, administrative convenience is also important where the central government must distribute and redistribute so many water rights. Since crop patterns may change annually, it would be very difficult to tailor water rights to such variable irrigation water needs.

A second kind of complaint, that against central government control in general, might be closely related to the lack of individual treatment just discussed. No doubt the restricted volumes of water allowed by the "standards" will cause some indictment of the central planners. The local irrigator may resent government officials reducing his water rights on the basis of what to him is an obscure, theoretical test. The magnitude of any such resentment would be difficult to determine, and such a determination is clearly beyond the scope of this study. However, the recent experience of having the central government appoint a Water Distribution Commission to control the river during the drought may be instructive in predicting how Choapa Valley irrigators will react to outside control of water rights. But it should be noted that the Commission was not exactly outside intervention; many local water experts participated.¹¹⁸ There have been some complaints that the Commission delayed too long in making decisions since two of the three members did not live in the valley, but the Commission's administration has been generally well received. This general reaction indicates that some sort of administrative system could be applied to water delivery in the Choapa Valley.

Further, experience gained by the Commission and the irrigators may ease the way for full implementation of the "standards" and the establishment of more permanent water delivery organizations. According to CORA's plans, such organizations would include Supervisory Councils and Canal Users' Associations.¹¹⁹ Participation by the irrigators in settling their own disputes and managing their own water delivery would probably provide a sense of participation and an actual power base for influencing central government water policy. Though there is a growing interest among the irrigators in forming a Supervisory Council, no formal steps have been taken toward establishment of this organization. But there have been plans made for an "irrigation cooperative" of delegates from the irrigation committees in each cooperative or "settlement." All of these local irrigators' organizations should increase irrigator acceptance of a centrally determined "standard."

Finally, as a social matter, the campesinos might not adopt the new irrigation techniques that must be employed if water is delivered strictly according to the "standards." That reluctance might mean true obstruction of the application of the "standards," rather than mere resentment. Once again, this study is not sociological and cannot offer definite conclusions. However, campesino attitudes toward past attempts to introduce new irrigation or agricultural methods may indicate how the irrigators will react in the future. As mentioned earlier, low-intensity farming characterized the history of the Choapa Valley, so the campesinos have not used highly technical farming methods or advanced marketing procedures. As a result, CORA's suggestions for community pastures for cattle and cooperative marketing of farm products have not been well accepted.¹²⁰ But the farmers from one new

cooperative went to an experimental farm to learn new irrigation methods, so progress is being made. Nevertheless, the campesinos will probably continue to be somewhat independent and resistant to change. A period of successful demonstration of the new, more effective irrigation techniques will be necessary to convince the campesinos that such techniques are profitable and that their use is essential to deriving the optimum benefit from the small volume of water allowed by the "standards."

In view of the physical, institutional, administrative and social difficulties impeding full implementation of the "standards," many persons familiar with water rights and delivery in the Choapa Valley agree that the "standards of rational and beneficial use" are, for the moment at least, little more than theory. Such observers commonly assert that it will take ten years to apply the "standards" in the manner envisioned by the drafters of the Agrarian Reform Law. One is likely to agree with that prediction after seeing the rough justice of present water delivery in the valley: a twig stuck into the canal bank to indicate how much water the canal should carry; or a water master arbitrating a dispute between two campesino irrigators and demonstrating the width of proper canal flow by spreading his hands apart like a fisherman measuring the one that got away.

VIII. CONCLUSION

The declarations of an "area of rationalization" and "standards of rational and beneficial use" have had at least one tangible, present result: land has been transferred to campesino cooperatives. Ironically, this result seems to have little to do with water rights redistribution in the valley. As discussed earlier, the declarations' effects on water rights and water delivery will not appear until the drought ends and the physical, institutional, administrative, and social obstacles are overcome. Full implementation of the "standards" remains, therefore, for the future. The delay in implementation and the degree to which it can be accomplished are unknown. The Choapa Valley has changed slowly in the past, and though recent events have accelerated that change, one would be foolish to expect immediate advancement in water management.

Nevertheless, optimistic speculations about the future of water use planning and distribution in the Choapa Valley and in Chile as a whole are in order. The declarations of an "area" and "standards" in the valley may very well have the salutary effects envisioned by the Agrarian Reform Law drafters who added these concepts and tools to Chilean water law. The declarations might have exactly the effects intended by the drafters, namely a distribution of water more in accord with irrigation needs than past distribution had been. It seems clear that the application of "standards" through new water rights would in some sense honor CORA's past practice of delivering water in relation to irrigated land area. Though the "standard" represents the addition of many other factors besides hectareage, that factor is now clearly a valid criteria for water rights distribution and water delivery.

It is particularly dangerous to speculate about the effect that water allocation according to the new "standards" might have on agricultural production in the Choapa Valley. Such production is influenced by so many variables that water reform cannot be isolated and evaluated separately. But the commonly accepted generalization holds that if irrigation water is allocated according to practical needs, agricultural production will increase. There is reason to hope for that result in the Choapa Valley.

If that result is forthcoming, the stated objectives of the Agrarian Reform Law will have been furthered. Land has already been distributed to campesino families, and if the interest in irrigation reform continues, the other two goals may be partially reached: agricultural production may increase, and the campesinos may exercise more control over their own affairs, as well as over those of the nation. Agricultural production could increase through allocating water carefully in accord with true requirements. Further, through the establishment of an excellent training and demonstration program, and the creation of water users' organizations, the campesinos could learn the modern irrigation methods necessary to apply the "standards" and to achieve more intensive, productive cultivation. By participating in such training and organization, the campesinos could learn not only to improve their production and achieve more economic independence, but also how to organize themselves to influence the irrigation policies of the central government. In these ways, the objectives of the agrarian reform proponents will have been at least partially achieved.

The Choapa Valley "area" and "standards" might also help accomplish another major goal of the drafters: improving water use planning. The experience gained in this valley may advance other river basin plans by

improving future calculations of irrigation requirements. The water use planners wanted the tools of an "area" and "standards" in order to increase efficiency of water use; the practice gained in the Choapa Valley should reveal what difficulties must be overcome and which planning techniques are most useful. As such techniques are improved, for example through the use of computers that allow more variables to be taken into account, all previous water use planning experience will be valuable.¹²¹ Such sophisticated planning techniques will require detailed information, but will be better able to accommodate individual farmers. The engineers, agronomists, and water use planners in general wanted the concepts of an "area" and "standards" included in the Agrarian Reform Law in order to control water rights assignment centrally and to apply modern planning techniques in that assignment. Now they have the opportunity and responsibility to use those concepts and techniques to satisfy national and local needs. The Choapa Valley case should at least yield the benefits of experience.

In reviewing the drafting of the Agrarian Reform Law water articles, it was noted that the technical-professionals had successfully exercised a great deal of influence over the law; that is, they provided themselves or their colleagues with ample powers to control water use. By succeeding in creating the devices of an "area" and "standards," they won an ideological or theoretical victory. The nature of water rights was changed, and the power of the central government over them was thereby increased. Further, the technical experts' influence was reflected in the power they gained within the government to control distribution and redistribution of water rights according to scientific criteria. Thus, the water law articles of the Agrarian Reform Law manifested power shifts within the government and

within the society itself. It appears that the drafters represented a new class of highly educated technocrats with an active interest in using their government, or political, positions to change the nation's social, political, and economic structure.

As laudible as the goals of a "scientific" reform may be, legislators and water lawyers should be aware that in carrying out such a reform much power is delegated to the technicians. Since many lawyers and legislators do not know how irrigation requirements are calculated, they have the mistaken belief that such calculations are exact and strictly objective. This study's analysis of the Choapa Valley "standards" should help dispel that misconception and point out possible hazards in delegating almost complete authority to a central planning body. The legislators should realize that simply putting technical professionals in charge of water rights redistribution will not change irrigation patterns; the classic problems of fitting central planning policies to reality in the field remain.

It is the field that is water law's most important and final locale; there one finds the resource and the user. Likewise, one finds "law in action" or, perhaps, "law in inaction." The "law" to a water user is the set of circumstances, legal or otherwise, that decides whether he is able to use water, in what way, and in what quantity. Regardless of codes or official decrees, law is hardly law unless it can impose its norms at the key point: in deciding who gets what. In that respect, the law is still evolving in the Choapa Valley. The water managers and government officials must develop the law in its fullest sense by changing the reality there; the paper barrier has been cleared, now the economic, administrative, and social obstacles must be overcome.

FOOTNOTES

¹Ley de Reforma Agraria (hereafter referred to as the Agrarian Reform Law) No. 16.640 published in the Diario Oficial (the official, legal newspaper in Chile) No. 26.804 on July 28, 1967.

²Comité Interamericano de Desarrollo Agrícola (CIDA), Chile: Tenencia de la Tierra y desarrollo socio-económico del sector agrícola (Santiago: 1966). This report on land tenure and agricultural economics in Chile served as a major source of information for the drafting and justification of the 1967 Agrarian Reform Law.

³The articles of the Agrarian Reform Law dealing with water, and prior water law still in effect, have been combined and promulgated in the 1969 Código de Aguas (hereafter referred to as the 1969 Water Code). The 1969 Water Code was published in the Diario Oficial No. 27.292 on March 12, 1969. In the text of this article citations will be to the articles of the Agrarian Reform Law. Citations to the 1969 Water Code will be given in footnotes.

⁴The "agricultural year" (año agrícola) is defined in Article 1-m of the Agrarian Reform Law as "the year beginning May 1 and ending April 30 of the following year..."

⁵Sales contract between CORA and the National Health Service (Servicio Nacional de Salud, SNS) on February 15, 1964. CORA was created in 1963 by Ley No. 15.020, and Reglamento D.F.L. No. 11, 1963. CORA was originally established to carry out the Agrarian Reform Law of 1962, passed under the administration of President Jorge Alessandri. Now CORA is charged with administering the 1967 Agrarian Reform Law.

⁶CORA inter-office memo, July 7, 1968.

⁷CORA inter-office memo, July 30, 1965.

⁸A detailed review of the Spanish water law and its influence on Chilean water law up to the 1951 Chilean Water Code can be found in Daniel L. Stewart, "Aspects of Chilean Water Law in Action: A Case Study," Ph. D. thesis, University of Wisconsin, 1967. This thesis will soon be published in Chile by the Editorial Jurídica de Chile.

⁹1855 Civil Code, Article 595. This Code was approved by the President of the Republic on December 14, 1855, but did not take effect until January 1, 1857.

"National property for public use" is public property owned by the State, meaning all the citizens of the country. However, the national government may place certain administrative restrictions on public use of that

property. The government, as the ruling body of the State, does not own the property. Government, rather than State, property is known as bienes fiscales, or government property. The government may treat government property as its own private property. Private property owned by individual citizens is known as bienes particulares. For a complete description of the meaning of "national property for public use," see Jorge Reyes Riveros, Naturaleza Jurídica del Permiso y de la Concesión Sobre Bienes Nacionales de Uso Público (Santiago: Editorial Jurídica de Chile, 1960).

Pedro Lira Urquieta and Lorenzo de la Maza, Régimen Legal de las Aguas en Chile (Santiago: Editorial Nascimento, 1940) is a standard work on Chilean water law under the 1855 Civil Code as amended.

¹⁰Código de Aguas (hereafter referred to as the 1951 Water Code) Ley No. 9.909 published in the Diario Oficial No. 21.960 on May 28, 1951.

Ana Hederra Donoso (ed.), Comentarios al Código de Aguas (Santiago: Editorial Jurídica de Chile, 1960) provides a complete description and analysis of the 1951 Water Code and summarizes prior Chilean water law.

Michael T. Lyon, "Modifications in the Water Law of Chile contained in the New Agrarian Reform Law" Land and Water Law Review 431 (September 1968) contains a summary of the 1951 Water Code and examines the water law amendments made by the 1967 Agrarian Reform Law.

¹¹1951 Water Code, Article 9.

¹²Ibid., Articles 10 and 11.

¹³Ibid., Articles 9 and 12.

¹⁴Ibid., Articles 12 and 23. Though the "right of advantageous use" was to be granted by the President, in practice an administrative agency, the Irrigation Administration (Dirección de Riego) in the Ministry of Public Works actually handled all water rights matters. Though the 1951 Water Code gave such administrative authority to the General Water Administration (Dirección General de Aguas), Article 7 of the Ley Aprobatoria, Ley No. 9.909, attached to the Code, vested the duties and responsibilities of the General Water Administration in the Irrigation Department (Departamento de Riego). The Department's name was changed to Dirección de Riego in 1953 by Article 23 of D. F. L. No. 150. The Irrigation Administration continued to administer Chilean water law by virtue of Decreto Supremo No. 620 signed on August 4, 1967 and published in the Diario Oficial on August 26, 1967. The General Water Administration was formally established by Decreto No. 626 of the Ministry of Public Works signed on July 3, 1969 and published in the Diario Oficial on November 12, 1969. The statutory powers of the Administration were granted to it by Public Works Decreto No. 1.115 dated November 14, 1969 and published in the Diario Oficial on January 6, 1970.

¹⁵1951 Water Code, Article 26.

¹⁶Ibid., Article 280.

¹⁷Interview with Irrigation Administration official. See footnote 14.

¹⁸Mensaje del Ejecutivo al Congreso Proponiendo la Aprobación del Proyecto de Ley de Reforma Agraria (hereafter referred to as the Mensaje), published in Ley de Reforma Agraria (Santiago: Editorial Nascimento, 1967), pp. 12-13.

¹⁹The committee members included Hugo Trivelli, Minister of Agriculture; Rafael Moreno, Vice-President of CORA; Jacques Chonchol, Vice-President of the Institute of Agrarian Development (INDAP); José Olivares; Jorge Orchard; José Luis Pistono; Juan del Canto; Rodrigo Santa Cruz; Professor José Luis Cea; Professor Francisco Jumplido; Senators Patricio Aylwin, Ignacio Palma and Tomás Reyes; and Congressmen Eduardo Cerda and Julio Silva Solar. Pedro Moral López and Solon Barraclough were key advisors to the committee. Antonio García, Juan Tolosa, Eugenio Lobos, Miroslav Kovacic, and Jorge Peña acted as advisors in drafting the water law provisions.

See Terry L. McCoy, "Agrarian Reform in Chile, 1962-1968: A Study of Politics and the Development Process", Ph.D. thesis, University of Wisconsin, 1969, for a description of the drafting of the Agrarian Reform Law, and the political context in which it was drafted and passed.

²⁰Previous to the passage of the Agrarian Reform Law, Jacques Chonchol, a highly important figure in drafting and securing passage of the law, stated that an effective agrarian reform was not possible if the government had to pay full commercial value for expropriated property. Jacques Chonchol, "Razones Económicas, Sociales y Políticas de la Reforma Agraria," in Oscar Delgado (ed.), Reformas Agrarias en la América Latina (Mexico: Fondo de Cultura Económica, 1965), p. 121.

²¹For discussions of the economics of resource allocation see J. Hirschleifer, J. DeHaven, and J. Milliman, Water Supply: Economics, Technology, and Policy (Chicago: University of Chicago Press, 1969) and S. Smith and E. Castle (eds.), Economics and Public Policy in Water Resources Development (Ames: Iowa State University Press, 1964).

²²Article 10, No. 10 of the Political Constitution of the Republic of Chile was amended by Ley No. 16.615 of January 20, 1967. The text of the amended article can be found in Ley de Reforma Agraria cited earlier. A complete explanation of the Constitutional amendment can be found in Enrique Evans de la Cuadra, Estatuto Constitucional del Derecho de Propiedad en Chile (Santiago: Editorial Jurídica de Chile, 1967), pp. 398 et seq. The Constitutional amendment facilitated the entire Agrarian Reform Law by allowing deferred payment for expropriation of property.

²³For a detailed analysis of the 1967 Agrarian Reform Law provision dealing with water see Lyon, op. cit., and Exposición Metódica y Coordinada de la Ley de Reforma Agraria de Chile (Santiago: Editorial Jurídica de Chile, 1968) compiled by the Agrarian Law and Legislation Department of the Agrarian Reform Training and Research Institute (ICIRA), a joint project of the Food and Agriculture Organization (FAO) of the United Nations, and the Chilean government.

²⁴Agrarian Reform Law, Article 94; 1969 Water Code, Article 11.

²⁵ Agrarian Reform Law, Article 122 No. 3; 1969 Water Code, Article 11.

²⁶ Agrarian Reform Law, Article 104; 1969 Water Code, Article 12.

²⁷ Ibid.

²⁸ Agrarian Reform Law, Articles 109 and 110; 1969 Water Code, Articles 30 and 31.

²⁹ Ibid.

³⁰ Ibid.

³¹ Agrarian Reform Law, Article 97; 1969 Water Code, Article 54.

³² See footnote 10.

³³ 1969 Water Code, Article 27.

³⁴ 1969 Water Code, Article 26.

³⁵ See California Constitution, Article XIV, section 3. For discussion of the use of "reasonable" and "beneficial" in California water law, see W. Hutchins, The California Law of Water Rights (Sacramento, California: U.S. Department of Agriculture, 1956), pp. 135-37; and H. Rogers, A. Nichols, Water for California (San Francisco: Bancroft-Whitney, 1967), Vol. I, pp. 236-239, 261-264. For a discussion of this aspect of water law throughout the United States, see R. Clark (ed.), Waters and Water Rights (Indianapolis: Allen Smith, 1967), Vol. I, pp. 67-69, 72-73, 83-93.

³⁶ Agrarian Reform Law, Articles 108, 110, and 111; 1969 Water Code, Articles 29, 31, 32. See also footnote 20.

³⁷ 1969 Water Code, Article 35. Article 121 of the Agrarian Reform Law (now Article 36 of the 1969 Water Code) allows the President to modify the "areas of rationalization."

³⁸ 1969 Water Code, Article 28.

³⁹ 1969 Water Code, Article 332.

⁴⁰ See footnote 14.

⁴¹ Ley de Asociaciones de Canalistas, No. 2.139, November 20, 1908. See Lira and De la Maza, op. cit., p. 149.

⁴²The provisions regarding Canal Associations are contained in the 1951 Water Code, Articles 81 et seq. (now 1969 Water Code, Articles 88 et seq.) The provisions concerning Water Communities can be found in that Code, Articles 146 et seq. (Now 1969 Water Code, Articles 152 et seq.)

The water distributed by the Canal Associations is divided into acciones, or shares. Often a small irrigator will have only a few shares or only a fraction of one. Under Article 117 of the 1951 Water Code, votes were counted by shares; and a vote would be counted only if it represented one share or if the fractions added up to make a whole share. Many small irrigators had very little if any voting power. Article 122 (45) of the 1967 Agrarian Reform Law (now 1969 Water Code, Article 123) gives each irrigator one vote per share as before, but then gives each irrigator a number of additional votes obtained by dividing the number of shares by the number of water users. Though this change may not help the very small irrigators, irrigators may significantly improve their minority position. In the example given below, B and C could not have obtained a majority of votes without the consent of two of the other irrigators under the 1951 Code. Now B and C need the agreement of only one other irrigator.

Water Users	Shares	1951 Votes	1967 Votes
A	100	100	170 (100 plus 70)
B	20	20	90 (20 plus 70)
C	30	30	100 (30 plus 70)
D	100	100	170 (100 plus 70)
<u>E</u>	<u>100</u>	<u>100</u>	<u>170</u> (100 plus 70)
5	350	350	700

$$350 \div 5 = 70$$

The provisions regarding Supervisory Councils are found in the 1951 Water Code, Articles 159 et seq. (now 1969 Water Code, Articles 165 et seq.) Since the Canal Associations and Water Communities take water from rivers, those organizations can be and often are members of a Supervisory Council.

⁴³Conversation with drafters and Irrigation Department Official.

⁴⁴Agrarian Reform Law, Articles 96 et seq. and Title XII; 1969 Water Code, First Book, Title II and Second Book, Title V.

Title XII, Chapter I of the Agrarian Reform Law (1969 Water Code, Second Book, Title VI) provides for the creation of a National Irrigation Enterprise (Empresa Nacional de Riego) that is to plan, construct and operate irrigation and drainage works.

⁴⁵See footnote 14.

⁴⁶Corporación de la Reforma Agraria (CORA), Plan Choapa (Santiago: 1968) p. 9. See also Corporación de Fomento de la Producción (CORFO), Geografía Económica de Chile, Texto Refundido (Santiago: 1967), pp. 119-151.

⁴⁷The area includes 8,000 square kilometers according to the Plan Choapa, page 13. But as Nathaniel Wollman, op. cit., pp. 2, 32, points out, statistics in Chile are not always consistent and dependable. For slightly different calculations of the area draining into the Choapa River, see Centro de Planeamiento, Facultad de Ciencias y Matemáticas, Universidad de Chile, Estudio de la Disponibilidad de Recursos Hidráulicos en Chile (Santiago: 1965), pp. 18, 63.

⁴⁸CORA, op. cit., p. 13; CORFO, op. cit., pp. 167-68. See also Centro de Planeamiento, op. cit., p. 86. Once again the figures in different reports differ.

⁴⁹CORA, op. cit., p. 7, and República de Chile, Dirección de Estadísticas y Censos, Síntesis Estadística Junio-1969, p. 12.

⁵⁰Stewart, op. cit. p. 60. See also María Isabel González Pomés, La Encomienda Indígena en Chile durante el siglo XVII (Santiago: Ediciones Historia, Universidad Católica de Chile, 1966) and Domingo Amunátegui Solar, Encomiendas de Indígenas en Chile, 2 vols. (Santiago: Imprenta Cervantes, 1910).

⁵¹Amunátegui Solar, op. cit., vol. 2, pp. 95-99.

⁵²Report by the National Health Service (SNS) in CORA files.

⁵³Transcript of will in CORA files.

⁵⁴Report by the National Health Service (SNS) in CORA files.

⁵⁵Report by the National Health Service (SNS) in CORA files.

⁵⁶Ibid. To demonstrate that the transfer was, indeed, to "substitute one pious work for another," the Bishop suggested that the legacy that Doña Matilde had left for the construction of a casa de ejercicios, a retreat for meditation, devotion, and prayer in Cuz Cuz (a village close to Illapel) could be given for the benefit of the orphan's home since devotional services could be held at the Hacienda Choapa or in private homes. He further submitted that the orphan's home represented a "daily, perpetual, and truly charitable aid to the more than one hundred masses that the National Treasurer says shall be devoted to Doña Matilde Salamanca's soul by the priest or priests named by the government to give spiritual guidance in the Orphan's Home."

⁵⁷Ibid.

⁵⁸The colonies of Santa Rosa and Chuchifi were established along the Choapa River. For a description of the colonies formed in the Illapel Valley, see Stewart, op. cit., p. 244 et seq.

⁵⁹Contract in CORA files.

⁶⁰M. Judith Astelarra, "Hacienda Choapa: Un Area Conflictiva," Thesis, Universidad Católica de Chile, 1968, p. 6.

⁶¹See footnote 5.

⁶²CORA, op. cit. p. 1.

⁶³Ibid. p. 13.

⁶⁴Ibid., pp. 102-103.

⁶⁵Ibid., p. 117. The figure seems to have first been published in P. Kleinman and J. Torres, Recursos de Agua del Valle de Choapa (Santiago: Corporación de Fomento de la Producción, 1963), p. 27.

⁶⁶Interview with Irrigation Department officials.

⁶⁷CORA, op. cit., p. 145.

⁶⁸The contract, in CORA files, allowing the Buzeta brothers to build the Canal Buzeta, the longest canal in the valley, is dated December 27, 1869.

⁶⁹See O. W. Israelsen and V. E. Hansen, Irrigation Principles and Practices (New York: Wiley and Sons, 1962), pp. 75-76, 99-145.

⁷⁰CORA file report, "Anteproyecto de Regadío del Curso Superior del Río Choapa," signed by W. Bennison, Ingeniero Civil, June 30, 1965 (hereafter cited as the Bennison report). See also Kleinman and Torres, op. cit., pp. 48-51, 121.

⁷¹These rights are known as either "vital rights" (derechos de la vida) or "drinking rights" (derechos de bebida). The volume of these rights is roughly two liters per second. Traditionally, the volume was that passing through a piquete, a triangular-shaped hole measuring one inch across the bottom and two inches from the bottom to the apex.

⁷²"Expediente Hacienda Choapa" in CORA files.

For a description of the water registry system, see Lyon, op. cit., pp. 439-41. It should be noted that the water registers are often incomplete.

⁷³Kleinman and Torres, op. cit., p. 96.

⁷⁴The formation of the arbitration boards was probably done under the provisions of a series of laws that granted powers to the President of the Republic or to various local officials and judges to distribute water in time of shortage. In general, these laws, Ley de Municipalidades (September 8, 1854), Ordenanza de Distribución de Aguas (January 3, 1872) and the Código de Procedimiento Civil (August 28, 1902), dealt with disputes on rivers that

flowed through two or more political subdivisions. Briefly, those laws taken together provided for submitting a natural watercourse to a turno in periods of water shortage. According to Lira and De la Maza, op. cit., p. 165, the proceedings could be initiated by "any interested party," who would go to the judge sitting nearest the river in question for a decision that a water shortage existed. If the judge so decided, the holders of water rights on the river designated representatives who would meet to "fix the proportion of water carried by each canal, which proportion would serve as a basis for turno distribution..." (ibid., p. 168 quoting the 1872 Ordenanza, Article 14). Once this basis was fixed, the distribution was to be carried out and enforced by an appointed juez de aguas, or water master.

See also Lyon, op. cit., pp. 438-39.

For a description of the operation of these provisions in the Illapel Valley, see Stewart, op. cit., pp. 84-182; and in the Putaendo Valley south of the Choapa, see R. Baraona, X. Aranda, and R. Santana, Valle de Putaendo, Estudio de Estructura Agraria (Santiago: Instituto de Geografía, Universidad de Chile, 1961) pp. 88-103.

⁷⁵Kleinman and Torres, op. cit., pp. 40-41, 119-120.

⁷⁶In the Putaendo Valley, the division of water rights and of water has long been based upon irrigated surface area; see Lagreze and Riobó, op. cit., pp. 138-39; Baraona, Aranda, and Santana, op. cit., pp. 73-103. Irrigated land area has also determined the volume of water each irrigator receives in the Illapel Valley; see Stewart, op. cit., p. 162.

⁷⁷Kleinman and Torres, op. cit., p. 8; CORA, op. cit., p. 138; Bennison report.

⁷⁸Decreto No. 613, Ministry of Public Works (July 31, 1969). For the descriptions of water distribution during the drought on the Aconcagua River, just south of the Choapa River, see Rubens Medina A., "La Comisión de las Aguas del Río Aconcagua," Estudios e Informaciones Sobre Derecho y Legislación de Reforma Agraria, No. 1-1969 (Santiago: Instituto de Capacitación e Investigación en Reforma Agraria), p. 72; and Jeffrey L. Jacobs, "The Distribution of Water in Chile Under Emergency Conditions: A Case Study of the Aconcagua River Valley During the Drought of 1968-1969" [unpublished] (Valparaíso: University of Wisconsin Land Tenure Center/Chile and the International Legal Center, 1969).

⁷⁹Decreto No. 245 D.G.A. Ministry of Public Works (September 9, 1968).

⁸⁰The declaration of a "drought zone" in the region was extended to August 31, 1969 by Decreto No. 610 Ministry of Public Works, (July 1, 1969) and to May 31, 1970 by Decreto No. 802, Ministry of Public Works. (August 27, 1969).

⁸¹Turnos between irrigators on a canal were divided into intervals as short as 15 minutes. In some places, irrigation "by the whistle" (al pito) was used. The canal tender (celador) would blow his whistle to signal the beginning of each turno so that the irrigator next in line would know that his water was coming down the canal.

The Water Distribution Commission followed precedent in establishing the type of organizational structure it did to carry out detailed water distribution. The Commission appointed a water master (juez del río) for each river or section of river under its jurisdiction. Each water master had assistant water masters (repartidores) under his supervision who were to see that the canal intake and discharge headgates were opened and closed on schedule. Usually, canal tenders, under the control of the assistant water masters, actually operated the gates.

Grievances about water distribution were channeled through the water masters up to the Commission. Appeals from the Commission's decisions could be taken to a national Coordinating Commission.

Violations of the Distribution Commission's orders were punished by depriving the offender of his water quota for a time, or by criminally prosecuting him for stealing water or damaging irrigation works.

⁸²Bennison report.

⁸³CORA inter-office memo.

⁸⁴Agrarian Reform Law, Article 66. According to the way in which land title is distributed, the cooperatives can be one of three basic types: individual, mixed, or communitarian. In the individual form, each family is assigned a specific parcel. But each family also owns a share of the cooperative, which owns the roads and other common land, machinery, and storehouses. In the mixed form of cooperative, each family has a small individual plot, as well as a share in common farmland owned by the cooperative. The common farmland, most likely orchards, vineyards, or pastures, is cultivated through community effort. In the purely communitarian form of cooperative, all the land is owned and cultivated in common. Each family is assigned a share in the cooperative, which holds title to all the assets. In each of the three forms, the cooperative acts as a consumer and marketing cooperative.

Article 1(t), (u), and (v) define the different forms of the cooperatives.

Article 67 of the Agrarian Reform Law deals with assignment of land and the forms in which such assignment can be made. For a discussion of this article and the others to which it refers, see ICIRA, Exposición Metódica..., pp. 89-92.

⁸⁵Agrarian Reform Law, Article 67.

⁸⁶These reports included a study of the Choapa's flow, canal seepage losses and return flow from canals performed for a joint National Health Service-CORA evaluation commission by Sr. Felipe Niguez, a civil engineer from Illapel. At almost the same time, the Production Development Corporation, COFFCO, ordered a study of the water resources of the Choapa and Illapel Valleys. That report was compiled by two civil engineers, P. Kleinman and J. Torres, who submitted the report for publication in 1963, see Kleinman and Torres, op. cit. They reviewed the hydrological data gathered since 1918 on the river, and the existing agricultural patterns and water use in the river basin. They also briefly discussed the land and water rights in effect at the time of their study. The study offered a number of conclusions and suggestions for future action: the construction of a water reclamation and stor-

age project, studies of ways to more efficiently use available water by more stringently restricting application of irrigation water, and the establishment of a permanent Supervisory Council on the Choapa River, ibid., pp. 6 et seq., 75 et seq.

⁸⁷See Harry F. Blaney and Wayne D. Criddle, Determining Consumptive Use and Irrigation Water Requirements, United States Department of Agriculture Technical Bulletin No. 1275 (1962). A summary and explanation of the formula may be found in Natural Resources Journal 29 (May 1964).

⁸⁸Israelsen and Hansen, op. cit., p. 253.

⁸⁹The rate at which a plant uses water increases as the plant grows and reaches the flowering stage, and the water use rate declines as life activity in the plant declines. Therefore, if a plant is harvested soon after flowering, as is alfalfa, its life-time average water use rate is high, whereas if harvest occurs after the plant has gone to seed, as with wheat or dry beans, the plant's average use of water over the growing season is lower, see Israelsen and Hansen, op. cit., p. 253.

⁹⁰The seasonal consumptive use rate is calculated as follows. The mean monthly temperatures for each month are multiplied by the appropriate monthly percentages of yearly daytime hours. The sum of these products is then multiplied by the seasonal empirical consumptive use coefficient to obtain the seasonal consumptive use rate. Where

t = Mean monthly temperature in degrees Fahrenheit

p = Monthly percentage of daytime hours of the year

$f = \frac{tp}{100}$ = Monthly consumptive-use factor

u = Monthly consumptive use, inches [of water]

U = Seasonal (growing season) consumptive use (or evapotranspiration), in inches

F = Sum of the monthly consumptive-use factors for the growing season (sum of the products of mean monthly temperature and monthly percentage of daytime hours of the year). Or

$$F = \sum f = \sum \frac{tp}{100}$$

K = Empirical consumptive-use crop coefficient for growing season or irrigation season, then

U = KF

as shown in Blaney and Criddle, op. cit., p. 17.

⁹¹This plant growth-"k" curve roughly parallels the curve showing the rate of evaporation of water over the same growing season from an open surface, such as a pan. Studies have shown that when a plant with an expanding root or vegetative system is growing at its peak rate, the plant is using about the same amount of water as that evaporating from a pan, see Israelsen and Hansen, op. cit., p. 257. Thus, plant growth and consumptive

use are directly related to climatic conditions. Blaney and Criddle measured the monthly volume of water used by various plants and related those volumes to the temperatures and daytime hours during that month to obtain "k's." "k" then represents a mathematical constant or coefficient relating consumptive use to temperature and hours of daylight. Mathematically expressed, the formula is:

$$k = \frac{u}{f}$$

So by knowing the monthly "k" for a given crop, the mean monthly temperature and the percentage of yearly daylight hours that occur in that month, monthly consumptive use is thus calculated:

$$u = kf = k \frac{tp}{100}$$

as shown in ibid., p. 252.

⁹²Blaney and Criddle, op. cit., p. 25. Since not all rainfall is available for plant use, for example because of surface run-off, rainfall figures have to be discounted according to a table they provide on p. 13.

⁹³Ibid., p. 22. Taking the rainfall and irrigation efficiencies into account, the formula for calculating total irrigation water requirements is:

$$\text{Irrigation Needs} = (U-R) \text{ Ef}$$

U = Seasonal consumptive use

R = Sum of the monthly rainfall in inches during the growing season.

Ef = Irrigation efficiency. See Harry F. Blaney, "Climate as an Index of Irrigation Needs" in Water, United States Department of Agriculture 1955 Yearbook of Agriculture, p. 341.

Irrigation efficiency can be of several types. Farm efficiency considers losses occurring between the farm headgate and the plants. Field efficiency considers only losses in a particular field. Unless transmission losses from the farm headgate to the field are nil, as in a pipeline, farm efficiency is lower than field efficiency. For a listing of the varieties of water losses and efficiencies see H. B. Roe, Moisture Requirements in Agriculture (New York: McGraw-Hill, 1950), pp. 161 et seq.

⁹⁴Blaney and Criddle, op. cit., pp. 22-25.

⁹⁵Ibid.

⁹⁶See CORFO, Geografía Económica de Chile, Primer Apéndice (Santiago: 1966), pp. 35-36.

In an interview in the Santiago office of CORA on July 29, 1969, Sr. Bennison stated that his rainfall, temperatures, and percentages of daylight hours were taken from "official figures."

A rainfall chart accompanying the consumptive use calculation indicates that the rainfall measurements were made at Salamanca, approximately at the midpoint of the Choapa Valley. The rainfall amounts in centimeters, beginning with May were: 3.6, 5.5, 7.1, 4.8, 1.6, 0.6, 0.4, 0.2, 0.1, 0.3, 0.9 and 1.9. The temperatures in Centigrade in the same order were: 11°, 8.6°, 9.6°, 10°, 10.5°, 14°, 16°, 18.8°, 19.1°, 17.8°, 16.3°, 15.1°.

⁹⁷The Plan Choapa states that the Choapa Basin is located between 31°26' and 31°53' of latitude. According to Blaney and Criddle, op. cit., p. 43, the values for percentages of annual daylight hours occurring in the months beginning with January are: 9.76, 8.36, 8.64, 7.70, 7.39, 6.85, 7.20, 7.73, 8.08, 9.04, 9.31, and 9.87. Bennison used the following percentages: 9.8, 9.2, 8.3, 8.0, 7.2, 7.1, 7.3, 7.6, 8.4, 8.7, 9.5, and 9.7.

⁹⁸The following chart shows the K values used by Bennison and the K value range suggested by Blaney and Criddle; op. cit., p. 19:

Crop	Blaney and Criddle	Bennison
Deciduous fruits	.60 - .70	.75
Evergreen fruits		.70
Avocado	.50 - .55	
Grapefruit	.55 - .65	
Orange and lemon	.45 - .55	
Corn, beans and lentils		.80
Corn	.75 - .85	
Beans	.60 - .70	
Wheat, barley	.75 - .85	.75
Pasture, alfalfa, tobacco and peppers		.80
Pasture grass	.75 - .85	
Alfalfa	.80 - .90	
Truck crops	.60 - .70	.70
Vineyard	.50 - .60	.55

⁹⁹Ibid., p. 23

¹⁰⁰Actual efficiencies seem to range between .25 and .50. For a discussion of irrigation rates and efficiencies, see Nathaniel Wollman, The Water Resources of Chile (Baltimore: Johns Hopkins Press, 1968), pp. 46 et seq., 78-79, 249 et seq.

¹⁰¹CORA, op. cit., pp. 117-122.

¹⁰²The formulation of the five types of "family economic units" was a complicated task. The economic criteria listed in the report were: number of work-days necessary for cultivation of various crops, net income yielded, debt retirement costs, investment costs, and housing costs. The technical criteria were: rational use of natural resources, maximum use of existing infrastructure (canals, roads, and buildings) cultivation customs, and traditional regional crops. The socio-political-economic criteria were: the effects of having campesinos rather than the State or latifundistas own the land (land tenure patterns), and the effect of having different cooperatives

based on individual or communitarian cultivation of the crops (land exploitation system). See CORA, op. cit., pp. 164-170.

The Agrarian Reform Law, speaking of land distribution, not land use planning, provides in Article 1(h) that land should be distributed to campesino families in a "family agricultural unit" defined as:

...the amount of land that, given the quality of soil, location, topography, climate, cultivation possibilities and other characteristics, particularly the land's use capacity, being cultivated personally by the producer, permits the family group to live and to prosper through rational, advantageous use.

The Agrarian Reform Law also provided a way to relate the "family agricultural unit" to communitarian farming under the mixed or communitarian cooperatives. The second paragraph of Article 1(h) provided:

If the assignment of land is in the mixed form, the area of the family agricultural unit shall be determined by taking into account the additional income that may be earned as a result of receiving jointly assigned property or of being a member of a cooperative to which land is assigned.

¹⁰³CORA, op. cit., p. 117.

¹⁰⁴Ibid., pp. 117-22.

An hypothetical example may illustrate the Plan Choapa computations more clearly. Let it be assumed that according to prospective crop pattern plans, 50% of one section is to be planted to alfalfa in December and that another 30% of the section will be in corn, and that the remaining 20% will be vineyard. Let it further be assumed that during that month, one hectare of alfalfa needs 2400 cubic meters of water, that one hectare of corn needs 2000 cubic meters, and that one hectare of vineyard needs 1500 cubic meters. The Plan Choapa multiplied the December water needs of each crop by the percentage of the section occupied by that crop. The resulting figures were then added to obtain the per-hectare irrigation needs of the section. Mathematically, the process was this: 50% of 2400 (1200) was added to 30% of 2000 (600) and to 20% of 1500 (300) to arrive at a sum of 2100 cubic meters of water per hectare. Those 2100 cubic meters were considered to be the per-hectare irrigation requirement in the section in December. As noted earlier, the 2100 cubic meter figure became the "standard" per hectare declared for December.

¹⁰⁵The largest volume is 1900 cubic meters per acre in one month. That volume approximately equals 25.8 cubic feet per second per hectare, or 10.44 cfs per acre.

¹⁰⁶Kleinman and Torres, op. cit., p. 76.

¹⁰⁷The equivalent volumes in acre-feet per acre per year are: 4.33, 4.25, and 3.89.

The Eastern Section, receiving 11,850 cubic meters per hectare per year, includes all the farms upstream from and including Quelén. The Central Section, receiving 13,000 cubic meters per hectare per year contains the farms upstream from Limáhuida to Quelén. The Western Section, receiving 12,950 cubic meters per hectare per year, encompasses the farms downstream from the Central Section to the Choapa and Illapel Rivers.

¹⁰⁸Kleinman and Torres, op. cit., pp. 75-77 suggested that irrigation water use could be decreased to only 10,050 cubic meters per hectare per year, the optimum irrigation rate proposed for use in the Huasco and Copiapó Valley further to the north. In terms of their calculation of actual use, they suggested that the present irrigation rate could be decreased by half. Wollman, op. cit., pp. 78-85, calculated that farm irrigation rates could be reduced to 12,700 cubic meters per hectare per year and even to 11,800 if natural pasture were eliminated in a zone that included the Choapa Valley. A recent Chilean engineering thesis, Fernando Herrera Ruiz, "Mejoramiento del Regadío en el Valle de Choapa, Embalse Canalillo," Thesis, Escuela de Ingeniería, Universidad de Chile, 1967, pp. 30, 152-53, submitted that irrigation water use in the Choapa Valley could be reduced from 21,400 (a figure taken from the Kleinman and Torres report) cubic meters per hectare per year to only 13,000. All of these "rationalized" figures must be considered to be ideal irrigation rates.

¹⁰⁹See footnote 85.

¹¹⁰CORA inter-office report.

¹¹¹Letter from the Legal Counsel of CORA to the Minister of Public Works, August 13, 1968 and letter from Minister of Agriculture to the Minister of Public Works, undated CORA file copy.

¹¹²Decreto No. 1080, Ministry of Public Works, December 4, 1968, published in the Diario Oficial on December 28, 1968.

¹¹³Interview with Irrigation Department officials and comparison of Plan Choapa figures with published "standards."

¹¹⁴The "standards" were stated in terms of cubic meters per month, whereas local irrigators are accustomed to measurements in liters per second or no volumetric measurements at all. Further, the figures were complicated. Even local water managers understood neither the manner in which the "standards" had been calculated, nor the meaning of all the figures included.

¹¹⁵Decreto No. 412, Ministry of Public Works, April 30, 1969, published in the Diario Oficial on May 19, 1969.

¹¹⁶CORA, op. cit., p. 141.

¹¹⁷See "Organización Institucional para el Estudio y Formulación de Anteproyectos Integrales de Riego" (unpublished mimeograph) Ministerio de Agricultura, Oficina de Planificación Agrícola, March 1968. See also "El

Agua y su Mejor Aprovechamiento: Problema Básico de la Agricultura," a collection of speeches presented at an irrigation seminar held under the auspices of the Sociedad Nacional de Agricultura on January 21 and 22, 1969.

At the present time, CORFO is attempting to organize a water information library containing reports put out by all the Chilean government agencies dealing with water use. Further, President Frei formed a National Irrigation Commission composed of the Ministers of Agriculture and Public Works, as well as officials in agencies such as CORFO, the Budget Department, the Agriculture and Livestock Service, and the Office of Agricultural Planning. The Commission is to advise the President on irrigation policy. See El Mercurio, July 4, 1969.

¹¹⁸The Livestock and Agricultural Service's delegate to the Commission was an Illapel farmer and the Irrigation Administration's delegate had helped distribute water in the Choapa Basin for some fifteen years. Further, the Commission appointed water masters and assistant water masters who had been elected and approved by the irrigators.

¹¹⁹CORA, op. cit., p. 138.

¹²⁰Interviews with CORA employees in Salamanca.

¹²¹For a description of a pioneering effort in the use of computers for agricultural planning in Chile, see José Olivares, Programación del Uso de la Tierra en una Zona de la Reforma Agraria (Santiago: Instituto de Economía y Planificación, Universidad de Chile, 1968).